



Stormwater Impact Analysis and Final Design of SCM

The Point / AWH-20000 / November 2020



THE POINT

PACKAGE 1

ROLESVILLE, NORTH CAROLINA

STORMWATER IMPACT ANALYSIS AND FINAL DESIGN OF SCM

CONSTRUCTION DRAWINGS
PLANNING #: SUP 18-09

PROJECT NUMBER:

AWH-20000

DESIGNED BY:

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DATE: NOVEMBER 2020



MCADAMS
2905 MERIDIAN PARKWAY
DURHAM, NORTH CAROLINA 27713
NC LIC. # C-0293



NC LIC. # C-0293

THE POINT

Stormwater Impact Analysis-CD Package 1

GENERAL DESCRIPTION

The Point is a proposed residential development in Rolesville, North Carolina, located between Highway 401 and East Young Street/Rolesville Road. The development is approximately 300 acres, divided into a northern parcel (to be developed at a later date) and a southern parcel. This Stormwater Impact Analysis covers the development of the southern parcel only. The development will consist of approximately 804 lots, a mixture of townhomes and various types of single-family housing, thirteen stormwater control measures, sidewalks, roadways, greenway trail, and associated infrastructure. At this time stormwater control measures have been developed to a construction level for a portion of the site referred to as CD Package 1. This package includes 5 stormwater control measures.

The project site is located in the Neuse River Basin, and drains to Harris Creek (Peeples Creek / Wake Crossroads Lake) (BIMS # 27-26) and is classified as C;NSW. Per Town of Rolesville regulations, stormwater management on this site shall meet the stormwater management performance standards for development set forth in the Rolesville Unified Development Ordinance Article 7, Section 7.5.4 – Standards.

The regulations are as follows:

(B) Standards Based on Project Density

(4) Development Standards for High-Density Projects High-Density Projects shall implement stormwater control measures that comply with each of the following standards, in addition to the General Standards found in subsection B of this Section:

- (a) The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.
- (b) All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85 percent average annual removal for Total Suspended Solids (TSS).
- (c) All Development and Redevelopment projects required to manage storm water shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the storm water management plan. BMPs are to be in accordance with and as specified in the Design Manual.
- (d) Structural and Non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-Development conditions for the one-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.
- (e) General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual;
- (f) All Development and Redevelopment shall be located outside the Riparian Buffer Zone and the Flood Protection Zone. These Zones shall be in accordance with the following provisions:
 - i. Except where other applicable buffer standards are more restrictive, the Riparian Buffer Zone shall extend a minimum of 50 feet landward of all Perennial and Intermittent Surface Waters. The most restrictive standards shall apply.
 - ii. The Riparian Buffer Zone shall remain undisturbed unless otherwise permitted by this section.
 - iii. The Flood Protection Zone shall extend throughout the FEMA 100-year floodplain as identified on the current Flood Insurance Rate Map (FIRM) published by FEMA. The Flood Protection Zone shall remain undisturbed unless otherwise permitted by this section.
 - iv. No Development or Redevelopment is permitted within the Riparian Buffer Zone or the Flood Protection Zone except for stream bank or shoreline restoration or stabilization, water dependent

structures, and public or private projects such as road crossings and installations, utility crossings and installations, and greenways, where no practical alternatives exist.

v. Permitted activities within the Riparian Buffer Zone and the Flood Protection Zone shall minimize impervious coverage, direct runoff away from surface waters to achieve diffuse flow, and maximize the utilization of Non-structural BMPs.

vi. Where the Riparian Buffer Zone and the Flood Protection Zone both are present adjacent to surface waters, the more restrictive shall apply.

(g) The approval of the stormwater permit shall require an enforceable restriction on property usage that runs with the land, such as recorded deed restrictions or protective covenants, to ensure that future Development and Redevelopment maintains the site consistent with the approved project plans. Buffer widths and locations shall be clearly delineated on all plans, final plat, and as-builts.

(B) General Standards

(1) **Downstream Impact Analysis** The downstream impact analysis must be performed in accordance with the "ten percent rule," and a copy of the analysis must be provided with the permit application. The purpose of the downstream impact analysis is to determine if the project will cause any impacts on flooding or channel degradation downstream of the project site. The analysis must include the assumptions, results and supporting calculations to show safe passage of post-Development design flows downstream. This analysis shall be performed at the outlet(s) of the site, and downstream at each tributary junction to the point(s) in the conveyance system where the area of the portion of the site draining into the system is less than or equal to ten percent of the total drainage area above that point.

(2) Standards for Stormwater Control Measures

(a) **Evaluation According to Contents of Design Manual** All stormwater control measures and stormwater treatment practices (or BMPs) required under this ordinance shall be evaluated by the Stormwater Administrator according to the policies, criteria, and information, including technical specifications and standards and the specific design criteria for each stormwater practice, in the Design Manual. The Stormwater Administrator shall determine whether proposed BMPs will be adequate to meet the requirements of this ordinance.

(b) **Determination of Adequacy; Presumptions and Alternatives** Stormwater treatment practices that are designed, constructed, and maintained in accordance with the criteria and specifications in the Design Manual will be presumed to meet the minimum water quality and quantity performance standards of this ordinance. Whenever an applicant proposes to utilize a practice or practices not designed and constructed in accordance with the criteria and specifications in the Design Manual, the applicant shall have the burden of demonstrating that the practice(s) will satisfy the minimum water quality and quantity performance standards of this ordinance. The Stormwater Administrator may require the applicant to provide the documentation, calculations, and examples necessary for the Stormwater Administrator to determine whether such an affirmative showing is made.

(c) **Separation from Seasonal High Water Table** For BMPs that require a separation from the seasonal high-water table, the separation shall be provided by at least 12 inches of naturally occurring soil above the seasonal high-water table.

CALCULATION METHODOLOGY

- Areas outside of the Package 1 area have been assumed to be undeveloped for the purposes of this analysis.
- Rainfall data for this area in the Rolesville, NC region is from NOAA Atlas 14. This data contains a depth-duration-frequency (DDF) table describing rainfall depth versus time for varying return periods in the area. These rainfall depths are input into the meteorological model within PondPack for peak flow rate calculations. Please

reference the precipitation information within the Miscellaneous Site Information section of this report for additional information.

- On-site and off-site soils were determined using best available GIS data sources.
- Soil Conservation Service Curve Numbers (SCS CN) were selected from Table 2 of the USDA TR-55 for the land use that is most similar to the zoning type or cover condition.
- Land cover conditions for the pre-development condition were taken from survey provided by WithersRavenel and aerial imagery for the site. Land cover conditions for the post-development condition were taken from the proposed layout. Offsite cover conditions were based on GIS-based zoning mapping, provided by the Town of Rolesville.
- The time of concentration was calculated using SCS TR-55 (Segmental Approach, 1986). The Tc flow path can be divided into three segments: overland flow, concentrated flow, and channel flow. The travel time was then computed for each segment, from which the overall time of concentration was determined by taking the sum of each segmental time.
- Existing topographic information used in this analysis is from survey provided by WithersRavenel and QL2 LiDAR from North Carolina's Spatial Data Download.
- PondPack Version V8i was used in determining the pre- & post-development peak flow rates for the 1- and 10-year storm events, as well as routing calculations for the proposed stormwater control measures.
- For 100-year storm routing calculations, a "worst-case" condition was modeled in order to ensure the proposed facility would safely pass the 100-year storm event. The assumptions used in this scenario are as follows:
 - The starting water surface elevation in the facility, just prior to the 100-year storm event, is at the invert of the secondary orifice. This scenario could occur as a result of a clogged primary orifice or a rainfall event that lingers for several days. This could also occur as a result of several rainfall events in a series, before the low-flow orifice has an opportunity to draw down the storage pool.
 - Approximately 1-foot of freeboard is provided between the peak elevation during the "worst-case" scenario and the top of the dam for the proposed facility.

To meet the above Town of Rolesville standards, thirteen stormwater control measures (SCMs) have been proposed.

DISCUSSION OF RESULTS

PEAK RUNOFF CONTROL REQUIREMENTS

As shown in the Summary of Results section of this SIA, the proposed stormwater control measures provide the necessary peak runoff control for the proposed build-out condition of the development such that there are no calculated increases in the 1- and 10-year storm events at any point of analysis leaving the site.

POLLUTANT AND NUTRIENT CONTROL REQUIREMENTS

The proposed SCM is designed to the Minimum Design Criteria of the NCDEQ Stormwater Design Manual. Therefore, the proposed development is treated for 85% TSS removal and provides nitrogen and phosphorus treatment.

CONCLUSION

If the development on this tract is built as proposed within this report, then the requirements set forth in Town of Rolesville regulations will be met without additional stormwater management facilities. However, modifications to the proposed development may require that this analysis be revised. Some modifications that would **require** this analysis to be revised include:

1. The proposed site impervious surface exceeds the amount accounted for in this report.
2. The post-development watershed breaks change significantly from those used to prepare this report.

The above modifications may result in the assumptions within this report becoming invalid. The computations within this report will need to be revisited if any of the above conditions become apparent as development of the proposed site moves forward.

1	SUMMARY OF RESULTS
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4	POST-DEVELOPMENT HYDROLOGIC CALCULATIONS
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6	STORMWATER CONTROL MEASURE 'C' DESIGN FILES
7	STORMWATER CONTROL MEASURE 'D' DESIGN FILES
8	STORMWATER CONTROL MEASURE 'E' DESIGN FILES
9	STORMWATER CONTROL MEASURE 'F' DESIGN FILES
10	CULVERT DESIGN CALCULATIONS

SUMMARY OF RESULTS

RELEASE RATE MANAGEMENT RESULTS

POINT OF ANALYSIS #1			
Return Period	Pre-Dev [cfs]	Post-Dev [cfs]	% Increase [%]
1-Year	283.5	227.0	-20%
10-Year	545.3	506.3	-7%

POINT OF ANALYSIS #2			
Return Period	Pre-Dev [cfs]	Post-Dev [cfs]	% Increase [%]
1-Year	77.3	70.4	-9%
10-Year	153.0	139.4	-9%

POINT OF ANALYSIS #4			
Return Period	Pre-Dev [cfs]	Post-Dev [cfs]	% Increase [%]
1-Year	344.2	289.1	-16%
10-Year	704.1	653.6	-7%

STORMWATER CONTROL MEASURE 'A' SUMMARY

Design Drainage Area =	12.44	ac
Design Impervious Area =	6.83	ac
% Impervious =	54.9%	
Top of Dam =	386.00	ft
NWSE =	380.00	ft
WQv Ponding Elevation =	381.79	ft
Required Main Pool Surface Area at NWSE =	10,309	sf
Total Surface Area Provided at NWSE =	11,282	sf
Estimate of Provided Main Pool Surface Area at NWSE =	8,334	sf
WQv Orifice Diameter =	2.25	in
WQv Orifice Invert Elevation =	380.00	ft
Riser Size =	4' x 4'	
Riser Crest =	383.75	ft
Barrel Diameter =	30	in
# of Barrels =	1	
Upstream Invert =	379.00	ft
Downstream Invert =	378.00	ft
Length =	46.4	ft
Slope =	0.0216	ft/ft
Number of Orifices =	1	
Orifice Invert Elevation =	382.00	ft
Orifice Width =	36.00	in
Orifice Height =	6.00	in

STORMWATER CONTROL MEASURE 'A' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	32.8	3.9	382.51	3.49
10-Year	64.3	21.6	384.13	1.87
25-Year	75.3	40.1	384.49	1.51
100-Year	91.2	56.8	384.95	1.05

STORMWATER CONTROL MEASURE 'C' SUMMARY

Design Drainage Area =	15.68	ac
Design Impervious Area =	9.14	ac
% Impervious =	58.3%	
Top of Dam =	382.00	ft
NWSE =	376.00	ft
WQv Ponding Elevation =	377.97	ft
Required Main Pool Surface Area at NWSE =	12,977	sf
Total Surface Area Provided at NWSE =	13,922	sf
Estimate of Provided Main Pool Surface Area at NWSE =	10,506	sf
*Assume main pool 80% of total normal pool area		
WQv Orifice Diameter =	2.50	in
WQv Orifice Invert Elevation =	376.00	ft
Riser Size =	5' x 5'	
Riser Crest =	380.00	ft
Barrel Diameter =	42	in
# of Barrels =	1	
Upstream Invert =	374.50	ft
Downstream Invert =	372.00	ft
Length =	48.94	ft
Slope =	0.0511	ft/ft
Number of Orifices =	3	
Orifice Invert Elevation =	378.25	ft
Orifice Width =	36.00	in
Orifice Height =	9.00	in

STORMWATER CONTROL MEASURE 'C' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	43.5	8.3	378.55	3.45
10-Year	83.2	37.5	379.95	2.05
25-Year	97.0	53.5	380.32	1.68
100-Year	116.8	75.3	380.65	1.35

STORMWATER CONTROL MEASURE 'D' SUMMARY

Design Drainage Area =	13.21	ac
Design Impervious Area =	6.68	ac
% Impervious =	50.6%	
Top of Dam =	360.00	ft
NWSE =	354.00	ft
WQv Ponding Elevation =	355.11	ft
Required Main Pool Surface Area at NWSE =	9,785	sf
Total Surface Area Provided at NWSE =	19,672	sf
Estimate of Provided Main Pool Surface Area at NWSE =	14,539	sf
*Assume main pool 80% of total normal pool area		
WQv Orifice Diameter =	2.75	in
WQv Orifice Invert Elevation =	354.00	ft
Riser Size =	4' x 4'	
Riser Crest =	358.00	ft
Barrel Diameter =	24	in
# of Barrels =	1	
Upstream Invert =	353.00	ft
Downstream Invert =	352.00	ft
Length =	48.27	ft
Slope =	0.0207	ft/ft
Number of Orifices =	1	
Orifice Invert Elevation =	355.50	ft
Orifice Diameter =	8.00	in

STORMWATER CONTROL MEASURE 'D' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	28.0	0.5	355.83	4.17
10-Year	61.0	2.5	357.53	2.47
25-Year	73.0	6.7	358.18	1.82
100-Year	90.5	25.4	358.61	1.39

STORMWATER CONTROL MEASURE 'E' SUMMARY

Design Drainage Area =	17.20	ac
Design Impervious Area =	9.99	ac
% Impervious =	58.1%	
Top of Dam =	361.00	ft
NWSE =	355.00	ft
WQv Ponding Elevation =	356.59	ft
Required Main Pool Surface Area at NWSE =	14,578	sf
Total Surface Area Provided at NWSE =	19,072	sf
Estimate of Provided Main Pool Surface Area at NWSE =	14,351	sf
*Assume main pool 80% of total normal pool area		
WQv Orifice Diameter =	3.00	in
WQv Orifice Invert Elevation =	355.00	ft
Riser Size =	4' x 4'	
Riser Crest =	359.00	ft
Barrel Diameter =	36	in
# of Barrels =	1	
Upstream Invert =	354.00	ft
Downstream Invert =	353.00	ft
Length =	47.95	ft
Slope =	0.0209	ft/ft
Number of Orifices =	2	
Orifice Invert Elevation =	357.00	ft
Orifice Width =	36.00	in
Orifice Height =	6.00	in

STORMWATER CONTROL MEASURE 'E' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	50.1	6.0	357.39	3.61
10-Year	93.5	20.5	359.05	1.95
25-Year	108.5	36.6	359.45	1.55
100-Year	130.0	63.7	359.98	1.02

STORMWATER CONTROL MEASURE 'F' SUMMARY

Design Drainage Area =	18.53	ac
Design Impervious Area =	9.80	ac
% Impervious =	52.9%	
Top of Dam =	350.00	ft
NWSE =	344.00	ft
WQv Ponding Elevation =	346.02	ft
Required Main Pool Surface Area at NWSE =	14,086	sf
Total Surface Area Provided at NWSE =	14,748	sf
Estimate of Provided Main Pool Surface Area at NWSE =	11,358	sf
*Assume main pool 80% of total normal pool area		
WQv Orifice Diameter =	2.75	in
WQv Orifice Invert Elevation =	344.00	ft
Riser Size =	6' x 6'	
Riser Crest =	347.50	ft
Number of Weirs =	3	
Weir Length =	4.00	ft
Weir Inver El. =	346.25	ft
Barrel Diameter =	48	in
# of Barrels =	1	
Upstream Invert =	342.50	ft
Downstream Invert =	340.00	ft
Length =	47.58	ft
Slope =	0.0525	ft/ft

STORMWATER CONTROL MEASURE 'F' ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	73.6	33.1	347.19	2.81
10-Year	131.2	97.2	348.14	1.86
25-Year	150.7	111.4	348.38	1.62
100-Year	178.7	126.8	348.74	1.26

**POST-DEVELOPMENT
NITROGEN EXPORT CALCULATIONS**

TN-Loading Input Data

Sub-basin ID	Nitrogen Analysis Area [acres]				
	Open	Wooded	Impervious	Pond	Total
To SWMF	73.94	0.04	27.46	1.87	103.31
Bypass Area	147.76	42.42	2.61	6.96	199.74
Totals =	221.70	42.45	30.07	8.83	303.05

TN-Loading Output Data

Sub-basin ID	Nitrogen Analysis Area [acres]	TN-Load Before Treatment [lbs/yr]	% Removal	TN-Load After Treatment [lbs/yr]	BMP Type
To SWMF	103.31	673.23	30%	471.26	Wet Pond
Bypass Area	199.74	283.45	0%	283.45	-
Totals =	303.05	956.68		754.71	

Total TN-Load After Treatment =
= 754.71 lbs/yr
 2.49 lbs/ac/yr

Compute Estimated Offset Payment

Total Nitrogen Analysis Area =	303.05	acres
Max. TN-Export w/o Offset Payment =	1090.99	lbs/yr
	3.60	lbs/ac/yr
Computed TN-Export Before Treatment =	956.68	lbs/yr
	3.16	lbs/ac/yr
Computed TN-Export After Treatment =	754.71	lbs/yr
	2.49	lbs/ac/yr

POST-DEVELOPMENT
NITROGEN EXPORT CALCULATIONS

To SWMF

METHOD 2:

Quantifying TN Export from Residential / Industrial / Commercial Developments when Footprints of all Impervious Surfaces are shown.

- STEP 1:** Determine the area for each type of land use and enter in Column (2).
- STEP 2:** Total the areas for each type of land use and enter at the bottom of Column (2).
- STEP 3:** Multiply the areas in Column (2) by the TN export coefficients in Column (3) and enter in Column (4).
- STEP 4:** Total the TN exports for each type of land use and enter at the bottom of Column (4).
- STEP 5:** Determine the export coefficient for the site by dividing the total TN export from uses at the bottom of Column (4) by the total area at the bottom of Column (2).

(1) Type of Land Cover	(2) Area [acres]	(3) TN export coeff. (lbs/ac/yr)	(4) TN export from use (lbs/yr)
<i>Permanently protected undisturbed open space</i> (forest, unmown meadow)	0.00	0.6	0.00
<i>Permanently protected managed open space</i> (grass, landscaping, etc.)	75.85	1.2	91.02
<i>Impervious surfaces</i> (roads, parking lots, driveways, roofs, paved storage areas, etc.)	27.46	21.2	582.21
TOTAL	103.31	---	673.23

Total TN Export = 6.5 lbs/ac/yr
% impervious = 26.6%

POST-DEVELOPMENT
NITROGEN EXPORT CALCULATIONS

Bypass Area

METHOD 2:

Quantifying TN Export from Residential / Industrial / Commercial Developments when Footprints of all Impervious Surfaces are shown.

- STEP 1:** Determine the area for each type of land use and enter in Column (2).
- STEP 2:** Total the areas for each type of land use and enter at the bottom of Column (2).
- STEP 3:** Multiply the areas in Column (2) by the TN export coefficients in Column (3) and enter in Column (4).
- STEP 4:** Total the TN exports for each type of land use and enter at the bottom of Column (4).
- STEP 5:** Determine the export coefficient for the site by dividing the total TN export from uses at the bottom of Column (4) by the total area at the bottom of Column (2).

(1) Type of Land Cover	(2) Area [acres]	(3) TN export coeff. (lbs/ac/yr)	(4) TN export from use (lbs/yr)
<i>Permanently protected undisturbed open space</i> (forest, unmown meadow)	0.00	0.6	0.00
<i>Permanently protected managed open space</i> (grass, landscaping, etc.)	190.17	1.2	228.21
<i>Impervious surfaces</i> (roads, parking lots, driveways, roofs, paved storage areas, etc.)	2.61	21.2	55.24
TOTAL	192.78	---	283.45

Total TN Export = 1.5 lbs/ac/yr
% impervious = 1.4%

MISCELLANEOUS SITE INFORMATION



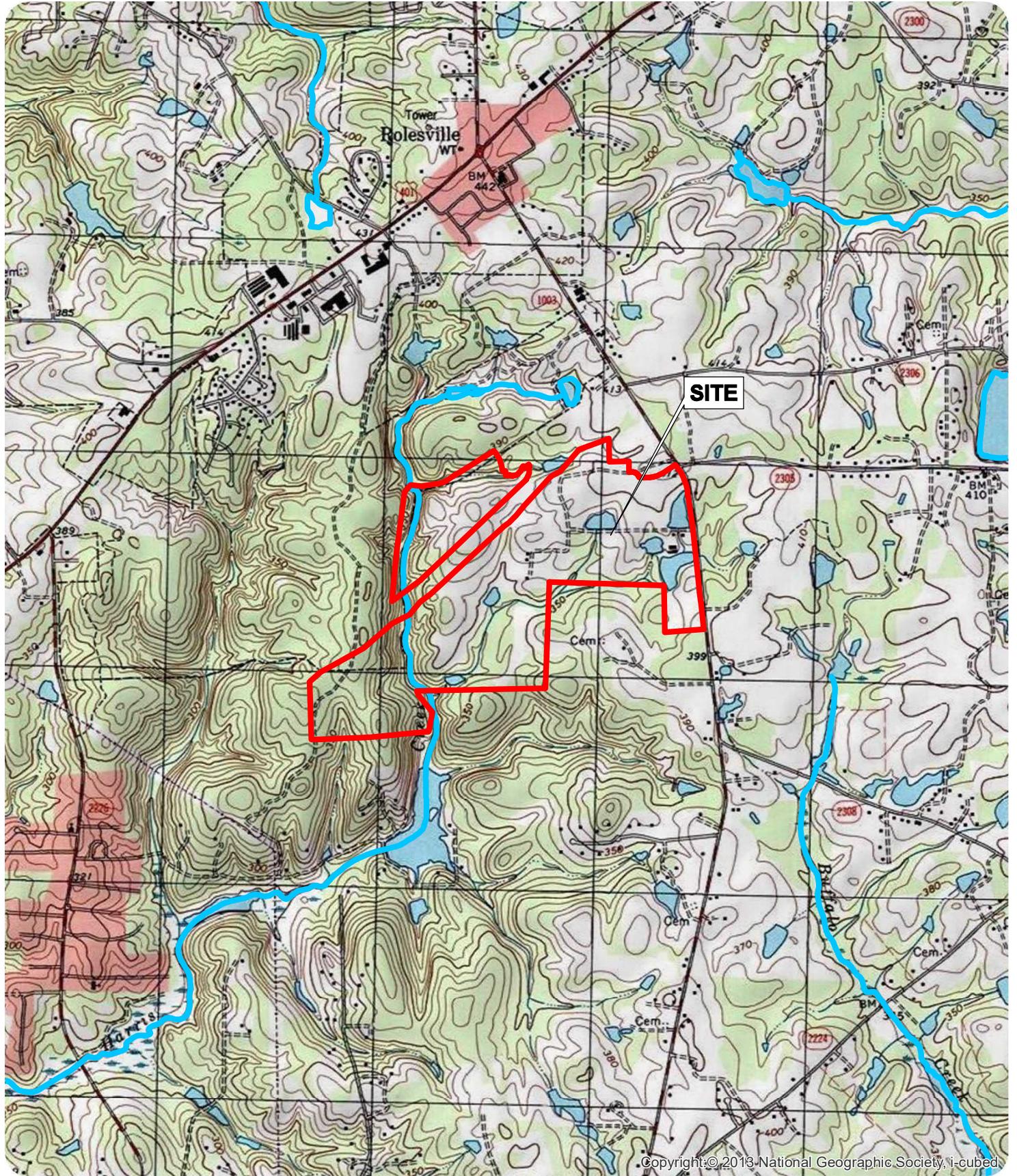
0 750 1,500 3,000
Feet

1 inch = 1,500 feet

**THE POINT
SITE AERIAL MAP
PROJECT #: AWH-20000
ROLESVILLE, NORTH CAROLINA**



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0 1,000 2,000 4,000
Feet
1 inch = 2,000 feet

THE POINT
USGS TOPO MAP
PROJECT #: AWH-20000
ROLESVILLE, NORTH CAROLINA



MCADAMS

.0315

NEUSE RIVER BASIN

Name of Stream	Description	Class	Class Date	Index No.
NEUSE RIVER	From a point 0.5 mile upstream of Town of Wake Forest proposed water supply intake to Town of Wake Forest proposed water supply intake	WS-IV;NSW,CA	07/01/04	27-(22)
NEUSE RIVER	From Town of Wake Forest proposed water supply intake to mouth of Beddingfield Creek	C;NSW	08/03/92	27-(22.5)
Smith Creek	From source to a point 0.3 mile downstream of Franklin-Wake County Line	WS-II;HQW,NSW	08/03/92	27-23-(1)
Smith Creek (Wake Forest Reservoir)	From a point 0.3 mile downstream of Franklin-Wake County Line to dam at Wake Reservoir	WS-II;HQW,NSW, CA	08/03/92	27-23-(1.5)
Smith Creek	From dam at Wake Forest Reservoir to Neuse River	C;NSW	05/01/88	27-23-(2)
Austin Creek (Mitchell Pond)	From source to Smith Creek	C;NSW	07/01/96	27-23-3
Hatters Branch	From source to Smith Creek	C;NSW	05/01/88	27-23-4
Spring Branch	From source to Hatters Branch	C;NSW	05/01/88	27-23-4-1
Sanford Creek	From source to Smith Creek	C;NSW	05/01/88	27-23-5
Toms Creek (Mill Creek)	From source to Neuse River	C;NSW	05/01/88	27-24
Perry Creek (Greshams Lake)	From source to dam at Greshams Lake	B;NSW	05/01/88	27-25-(1)
Perry Creek	From dam at Greshams Lake to Neuse River	C;NSW	05/01/88	27-25-(2)
Unnamed Tributary near Neuse	From source to dam at Camp Durant	B;NSW	05/01/88	27-25-3-(1)
Unnamed Tributary near Neuse	From dam at Camp Durant to Perry Creek	C;NSW	05/01/88	27-25-3-(2)
Harris Creek (Peeples Creek) (Wake Crossroads Lake)	From source to Neuse River	C;NSW	05/01/88	27-26
Hodges Mill Creek (Lake Mirl)	From source to water intake at Lake Mirl	B;NSW	05/01/88	27-26-1-(1)
Hodges Mill Creek	From water intake at Lake Mirl to Harris Creek	C;NSW	05/01/88	27-26-1-(2)
Beaverdam Creek (west side of Neuse River)	From source to Neuse River	C;NSW	05/01/88	27-27
Rocky Creek	From source to Neuse River	C;NSW	05/01/88	27-28
Beaverdam Creek (east side of Neuse River) (Neuseco Lake, Beaverdam Lake)	From soruce to Neuse River	C;NSW	05/01/88	27-29
Bridges Creek (Bridges Lake)	From source to Neuse River	C;NSW	05/01/88	27-30
Milburnie Creek (Milburnie Lake)	From source to Neuse River	C;NSW	05/01/88	27-31
Mango Creek	From source to Neuse River	C;NSW	05/01/88	27-32
Crabtree Creek	From source to backwaters of Crabtree Lake	C;NSW	05/01/88	27-33-(1)
Turkey Creek	From source to Crabtree Creek	C;NSW	05/01/88	27-33-2
Coles Branch	From source to Crabtree Creek	C;NSW	05/01/88	27-33-3
South Fork Coles Branch	From source to Coles Branch	C;NSW	05/01/88	27-33-3-1
Crabtree Creek (Crabtree Lake)	From backwaters of Crabtree Lake to mouth of Richlands Creek	B;NSW	04/01/94	27-33-(3.5)



This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long-term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has entered into a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
[HTTP://FRIS.NC.GOV/FRIS](http://FRIS.NC.GOV/FRIS)

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR Regulatory Floodway
0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile Zone X	
Future Conditions 1% Annual Chance Flood Hazard Zone X	
Area with Reduced Flood Risk due to Levee See Notes Zone X	
Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X	
Channel, Culvert, or Storm Sewer	
Accredited or Provisionally Accredited Levee, Dike, or Floodwall	
Non-accredited Levee, Dike, or Floodwall	
BM5510 x	
BM5510 ⊗	
BM5510 ◊	
Contractor Est. NCFMP Survey bench mark	
012-18-2	Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
8	Coastal Transect
—	Coastal Transect Baseline
—	Profile Baseline
—	Hydrographic Feature
—	Limit of Study
—	Jurisdiction Boundary

NOTES TO USERS

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Limit of Moderate Wave Action (LIMA)

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE
 This note may include approximate boundaries of the CBRS for insurance purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fema.gov/basihabconserv/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area

Otherwise Protected Area

SCALE

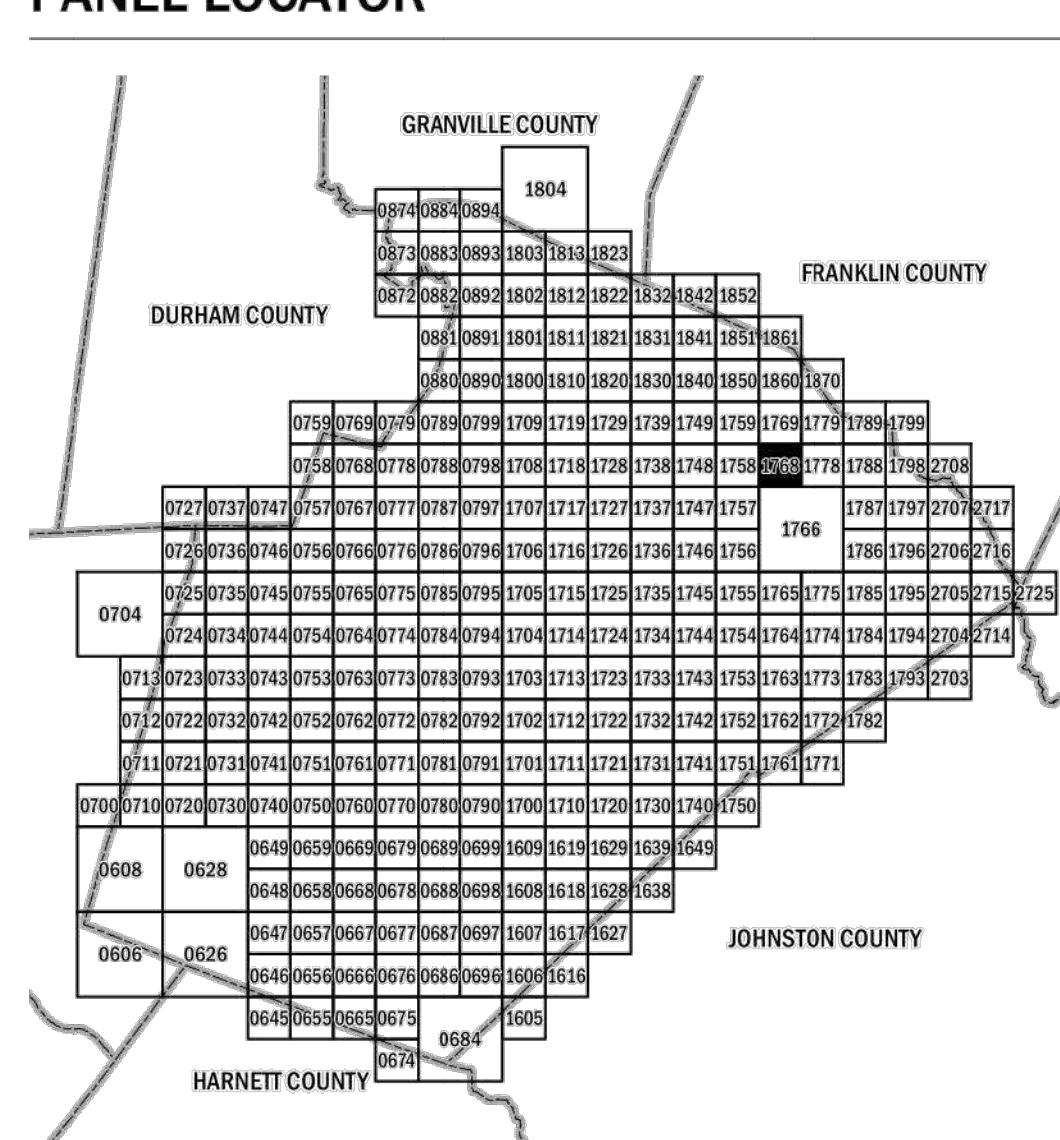
Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000
Feet

0 75 150 300
Meters

PANEL LOCATOR



NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 1768



Panel Contains:

COMMUNITY
ROLESVILLE, TOWN OF
WAKE COUNTY

CID PANEL SUFFIX
370468 1768 J
370368 1768 J

FEMA
National Flood Insurance Program

PANEL 1768

MAP NUMBER
3720176800J

MAP REVISED
05/02/06





This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the 1% level. As a part of this effort, the State of North Carolina has agreed in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
[HTTP://FRIS.NC.GOV/FRIS](http://FRIS.NC.GOV/FRIS)

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE)
Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile Zone X
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BM5510 x North Carolina Geodetic Survey bench mark

National Geodetic Survey bench mark

Contractor Est. NCFMP Survey bench mark

012-18-2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)

8 Coastal Transect

Coastal Transect Baseline

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CBRS Area

Otherwise Protected Area

SCALE

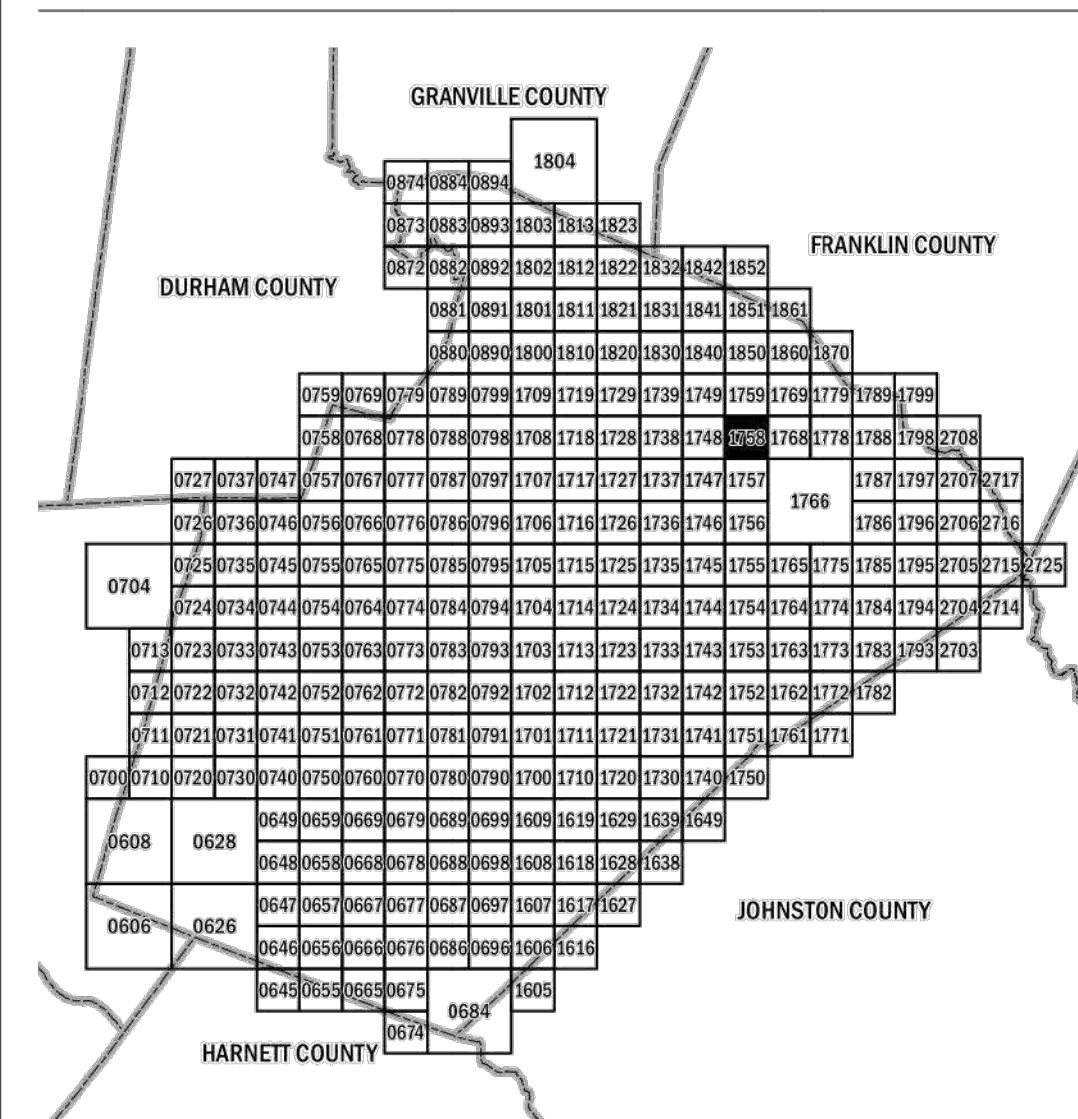


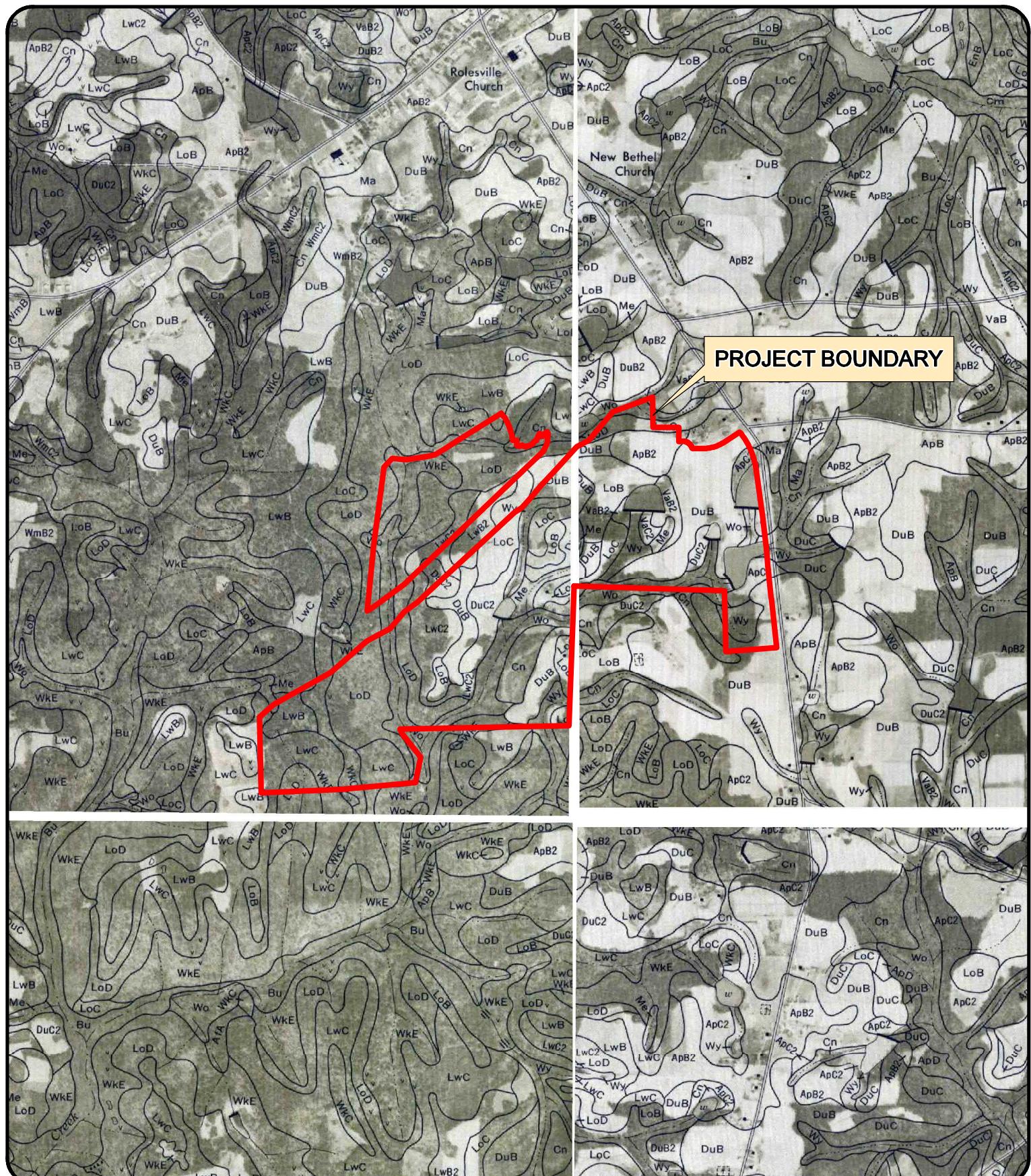
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North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000
Feet
0 75 150 300
Meters

PANEL LOCATOR





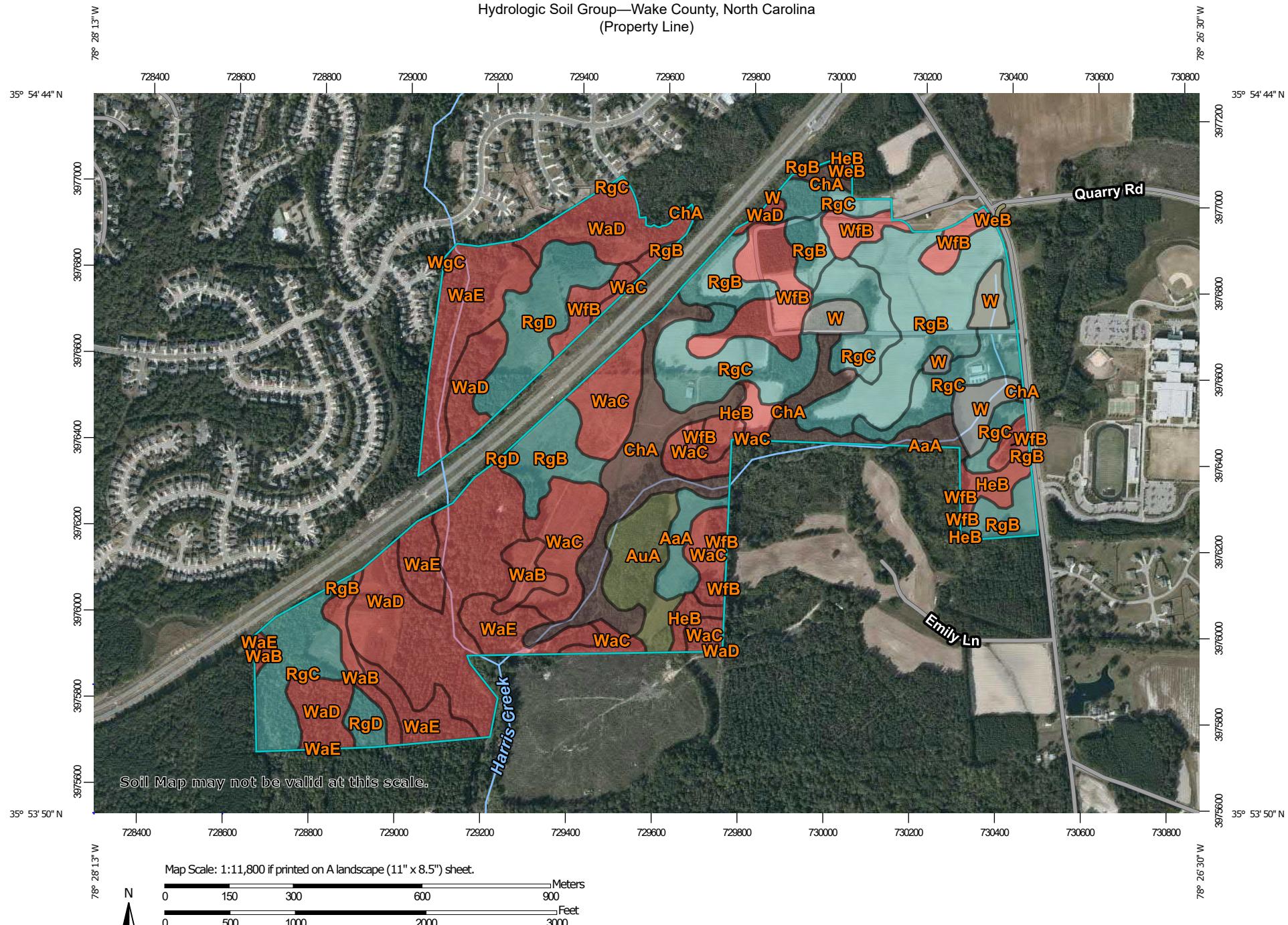
N
 0 750 1,500 3,000 Feet
 1 inch = 1,500 feet

THE POINT
SOIL MAP
PROJECT #: AWH-20000
ROLESVILLE, NORTH CAROLINA



McADAMS

Hydrologic Soil Group—Wake County, North Carolina
(Property Line)



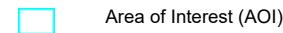
Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

6/3/2020
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)



Soils

Soil Rating Polygons

	A
	A/D
	B
	B/D
	C
	C/D
	D
	Not rated or not available

Soil Rating Lines

	A
	A/D
	B
	B/D
	C
	C/D
	D
	Not rated or not available

Soil Rating Points

	A
	A/D
	B
	B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Wake County, North Carolina

Survey Area Data: Version 18, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 11, 2019—Oct 19, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AaA	Altavista fine sandy loam, 0 to 4 percent slopes, rarely flooded	C	4.1	1.4%
AuA	Augusta fine sandy loam, 0 to 2 percent slopes, rarely flooded	C/D	10.1	3.3%
ChA	Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded	B/D	27.0	8.9%
HeB	Helena sandy loam, 2 to 6 percent slopes	D	7.1	2.4%
RgB	Rawlings-Rion complex, 2 to 6 percent slopes	C	43.5	14.4%
RgC	Rawlings-Rion complex, 6 to 10 percent slopes	C	45.6	15.1%
RgD	Rawlings-Rion complex, 10 to 15 percent slopes	C	15.0	5.0%
W	Water		9.7	3.2%
WaB	Wake-Rolesville complex, 2 to 6 percent slopes, very rocky	D	7.4	2.4%
WaC	Wake-Rolesville complex, 6 to 10 percent slopes, very rocky	D	29.0	9.6%
WaD	Wake-Rolesville complex, 10 to 15 percent slopes, very rocky	D	51.1	16.9%
WaE	Wake-Rolesville complex, 15 to 25 percent slopes, very rocky	D	28.9	9.6%
WeB	Wedowee sandy loam, 2 to 6 percent slopes	D	0.2	0.1%
WfB	Wedowee-Saw complex, 2 to 6 percent slopes	D	22.9	7.6%
WgC	Wedowee-Urban land complex, 6 to 15 percent slopes	D	0.1	0.0%
Totals for Area of Interest			301.6	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

**NOAA Atlas 14, Volume 2, Version 3****Location name:** Wake Forest, North Carolina, USA***Latitude:** 35.9053°, **Longitude:** -78.452°**Elevation:** 354.67 ft**

* source: ESRI Maps

** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)
PF tabular

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.403 (0.369-0.442)	0.468 (0.429-0.512)	0.534 (0.489-0.582)	0.600 (0.548-0.654)	0.666 (0.606-0.726)	0.718 (0.651-0.783)	0.765 (0.690-0.834)	0.807 (0.723-0.881)	0.853 (0.758-0.932)	0.895 (0.789-0.979)
10-min	0.644 (0.590-0.705)	0.749 (0.687-0.818)	0.855 (0.783-0.933)	0.959 (0.877-1.05)	1.06 (0.966-1.16)	1.14 (1.04-1.25)	1.22 (1.10-1.33)	1.28 (1.15-1.40)	1.35 (1.20-1.47)	1.41 (1.24-1.54)
15-min	0.806 (0.738-0.882)	0.942 (0.863-1.03)	1.08 (0.991-1.18)	1.21 (1.11-1.32)	1.35 (1.22-1.47)	1.45 (1.31-1.58)	1.54 (1.39-1.68)	1.61 (1.45-1.76)	1.70 (1.51-1.86)	1.77 (1.56-1.94)
30-min	1.10 (1.01-1.21)	1.30 (1.19-1.42)	1.54 (1.41-1.68)	1.76 (1.61-1.92)	1.99 (1.81-2.17)	2.18 (1.98-2.38)	2.35 (2.12-2.57)	2.51 (2.25-2.74)	2.70 (2.40-2.95)	2.87 (2.52-3.14)
60-min	1.38 (1.26-1.51)	1.63 (1.50-1.78)	1.97 (1.81-2.15)	2.29 (2.09-2.50)	2.65 (2.42-2.89)	2.96 (2.68-3.22)	3.24 (2.92-3.53)	3.52 (3.16-3.85)	3.88 (3.45-4.24)	4.18 (3.69-4.58)
2-hr	1.61 (1.46-1.78)	1.92 (1.75-2.10)	2.34 (2.13-2.56)	2.75 (2.49-3.01)	3.23 (2.91-3.54)	3.66 (3.28-4.00)	4.07 (3.63-4.45)	4.49 (3.98-4.91)	5.04 (4.42-5.51)	5.52 (4.80-6.05)
3-hr	1.71 (1.55-1.89)	2.03 (1.85-2.24)	2.49 (2.26-2.74)	2.94 (2.67-3.24)	3.50 (3.15-3.84)	3.99 (3.58-4.39)	4.49 (3.98-4.92)	5.00 (4.41-5.48)	5.69 (4.96-6.24)	6.32 (5.45-6.95)
6-hr	2.05 (1.87-2.26)	2.44 (2.23-2.68)	2.99 (2.72-3.28)	3.54 (3.22-3.88)	4.22 (3.82-4.62)	4.84 (4.35-5.29)	5.46 (4.86-5.96)	6.12 (5.39-6.67)	7.00 (6.10-7.64)	7.82 (6.72-8.55)
12-hr	2.41 (2.21-2.66)	2.87 (2.64-3.15)	3.54 (3.24-3.88)	4.21 (3.84-4.62)	5.07 (4.59-5.53)	5.85 (5.26-6.36)	6.64 (5.91-7.22)	7.49 (6.59-8.14)	8.66 (7.50-9.41)	9.76 (8.32-10.6)
24-hr	2.86 (2.66-3.08)	3.46 (3.22-3.73)	4.35 (4.04-4.69)	5.06 (4.69-5.44)	6.02 (5.57-6.49)	6.80 (6.27-7.32)	7.60 (6.98-8.19)	8.43 (7.71-9.09)	9.58 (8.71-10.3)	10.5 (9.50-11.3)
2-day	3.32 (3.09-3.57)	3.99 (3.72-4.30)	4.98 (4.64-5.37)	5.77 (5.35-6.21)	6.83 (6.32-7.36)	7.68 (7.09-8.27)	8.56 (7.87-9.22)	9.46 (8.66-10.2)	10.7 (9.74-11.6)	11.7 (10.6-12.7)
3-day	3.52 (3.28-3.77)	4.23 (3.94-4.54)	5.25 (4.89-5.63)	6.06 (5.64-6.50)	7.17 (6.64-7.69)	8.05 (7.44-8.64)	8.96 (8.25-9.62)	9.89 (9.07-10.6)	11.2 (10.2-12.1)	12.2 (11.1-13.2)
4-day	3.72 (3.47-3.98)	4.46 (4.17-4.77)	5.52 (5.15-5.90)	6.35 (5.92-6.79)	7.50 (6.96-8.01)	8.42 (7.79-9.00)	9.36 (8.63-10.0)	10.3 (9.49-11.1)	11.7 (10.7-12.5)	12.7 (11.6-13.7)
7-day	4.31 (4.04-4.61)	5.15 (4.82-5.50)	6.29 (5.88-6.71)	7.19 (6.72-7.68)	8.43 (7.85-9.00)	9.42 (8.75-10.1)	10.4 (9.66-11.2)	11.5 (10.6-12.3)	12.9 (11.8-13.9)	14.1 (12.8-15.1)
10-day	4.91 (4.61-5.24)	5.85 (5.48-6.23)	7.04 (6.60-7.50)	7.99 (7.47-8.50)	9.26 (8.64-9.86)	10.3 (9.55-10.9)	11.3 (10.5-12.0)	12.3 (11.4-13.2)	13.7 (12.6-14.7)	14.8 (13.6-15.9)
20-day	6.59 (6.20-7.02)	7.79 (7.32-8.29)	9.23 (8.67-9.81)	10.4 (9.72-11.0)	11.9 (11.1-12.7)	13.1 (12.2-14.0)	14.3 (13.3-15.3)	15.6 (14.5-16.6)	17.3 (16.0-18.5)	18.6 (17.1-19.9)
30-day	8.18 (7.72-8.69)	9.63 (9.08-10.2)	11.2 (10.6-11.9)	12.5 (11.7-13.2)	14.1 (13.2-15.0)	15.4 (14.4-16.3)	16.6 (15.5-17.7)	17.9 (16.7-19.0)	19.5 (18.1-20.9)	20.8 (19.3-22.3)
45-day	10.4 (9.89-11.0)	12.2 (11.6-12.9)	14.0 (13.3-14.8)	15.4 (14.6-16.2)	17.2 (16.3-18.1)	18.6 (17.5-19.6)	19.9 (18.7-21.0)	21.2 (19.9-22.5)	23.0 (21.5-24.4)	24.3 (22.7-25.8)
60-day	12.5 (11.9-13.1)	14.6 (13.9-15.4)	16.6 (15.7-17.4)	18.1 (17.1-19.0)	20.0 (19.0-21.1)	21.5 (20.3-22.6)	22.9 (21.6-24.1)	24.2 (22.9-25.6)	26.0 (24.5-27.5)	27.4 (25.7-29.0)

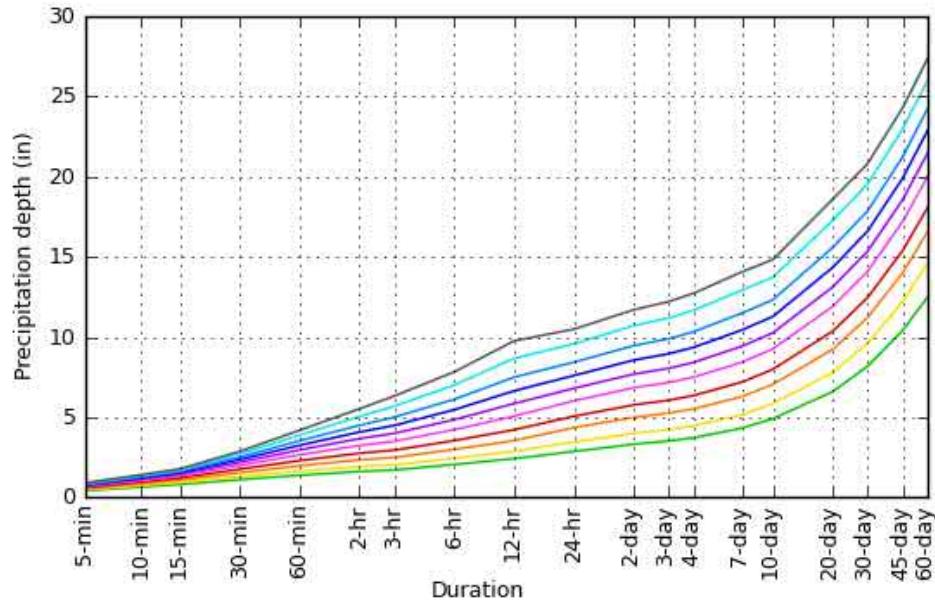
1 Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

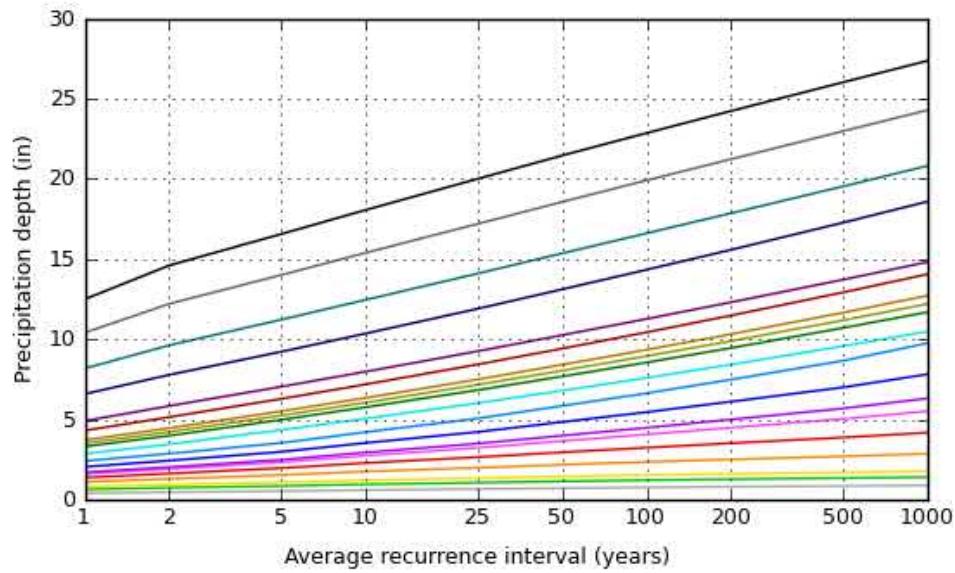
Please refer to NOAA Atlas 14 document for more information.

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PDS-based depth-duration-frequency (DDF) curves
Latitude: 35.9053°, Longitude: -78.4520°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

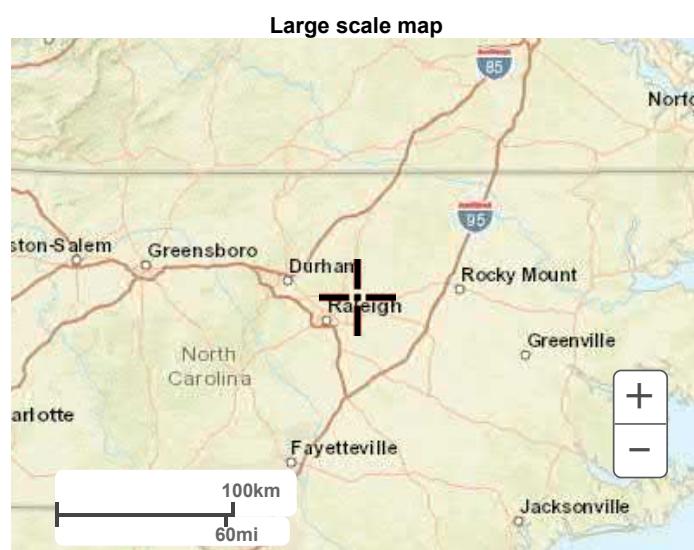
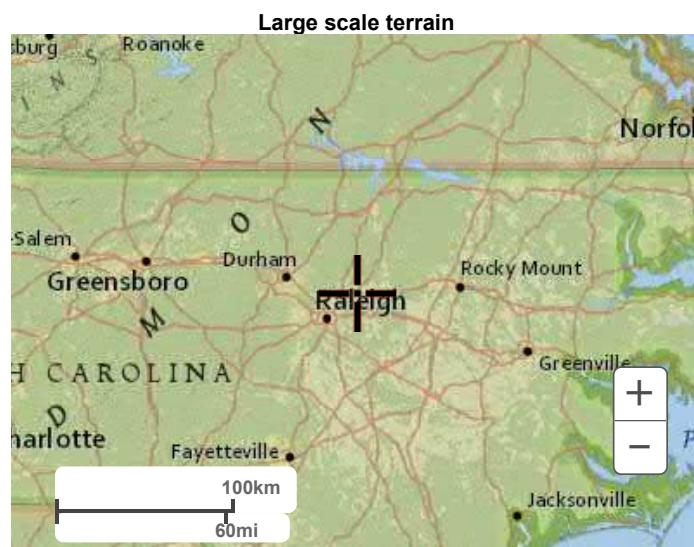
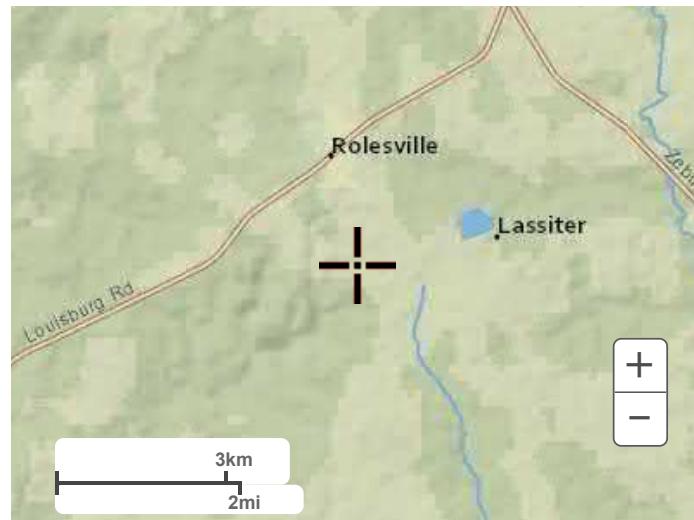
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Wed Jun 3 19:09:38 2020

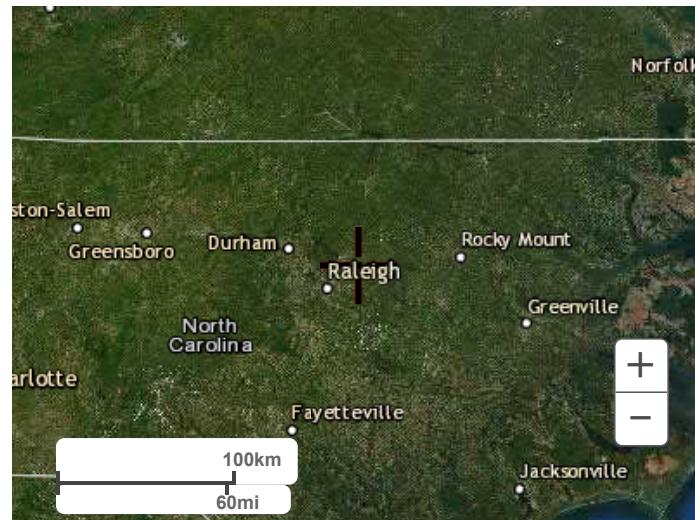
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Maps & aerials

[Small scale terrain](#)



Large scale aerial



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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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*PRE-DEVELOPMENT
HYDROLOGIC CALCULATIONS*

The Point
AWH-20000

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Total Area (ac)
Crops	B	78	Yes	0	0.00	23.79
Crops	B/D	89	Yes	0	0.00	0.13
Crops	D	89	Yes	0	0.00	6.70
Low Density Residential	B	68		20	0.06	0.29
Low Density Residential	D	84		20	4.53	22.63
Medium Density Residential	B	70		25	0.29	1.14
Medium Density Residential	D	85		25	0.02	0.08
Mixed Use Neighborhood	B	85		65	9.26	14.25
Mixed Use Neighborhood	B/D	92		65	2.68	4.12
Mixed Use Neighborhood	C	90		65	1.16	1.79
Mixed Use Neighborhood	D	92		65	10.60	16.30
Open	B	61	Yes	0	0.00	16.63
Open	B/D	80	Yes	0	0.00	0.38
Open	D	80	Yes	0	0.00	8.88
Pond	B	100	Yes	0	0.00	0.13
Pond	B/D	100	Yes	0	0.00	0.02
Pond	D	100	Yes	0	0.00	6.78
Roadway		98		100	7.98	7.98
Roof	B	98	Yes	100	0.35	0.35
Roof	D	98	Yes	100	0.00	0.00
School	B	88		72	12.90	17.91
School	B/D	93		72	6.11	8.49
School	D	93		72	43.84	60.89
Trail	B	82	Yes	100	0.52	0.52
Trail	B/D	89	Yes	100	0.01	0.01
Trail	D	89	Yes	100	0.11	0.11
Wooded	B	55	Yes	0	0.00	8.52
Wooded	B/D	77	Yes	0	0.00	6.40
Wooded	C	70	Yes	0	0.00	0.03
Wooded	D	77	Yes	0	0.00	1.61
Total Area		236.88 ac				
Total Impervious Area		100.42 ac				
Onsite Area		81.00 ac				
Onsite Impervious Area		0.99 ac				
Percent Impervious		42 %				
Composite Curve Number		89				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	426.00	ft
Bot Elev =	425.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	2645	ft
Top Elev =	425.00	ft
Bot Elev =	374.00	ft
Height =	51	ft
Slope =	0.0193	ft/ft
Paved ? =	No	
Velocity =	2.24	ft/sec
Segment Time =	19.68	minutes

Segment 3: Open Water Flow

Length =	580	ft
Top Elev =	374.00	ft
Bot Elev =	372.00	ft
Segment Time =	0.00	minutes

Segment 4: Channel Flow

Length =	2088	ft
Top Elev =	372.00	ft
Bot Elev =	344.00	ft
Height =	28	ft
Slope =	0.0134	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	15.00	sf (assume 5'w x 3'h channel)
Wetted Perimeter =	11.00	lf (assume 5'w x 3'h channel)
Channel Velocity =	4.72	ft/sec
Segment Time =	7.38	minutes

Time of Concentration =	40.80	minutes
SCS Lag Time =	24.48	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	7.10	minutes (= 0.29 * SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Crops	B	78	Yes	0	0.00	1.34
Crops	D	89	Yes	0	0.00	0.55
Low Density Residential	D	84		20	3.59	17.96
Mixed Use Neighborhood	B	85		65	3.44	5.30
Mixed Use Neighborhood	B/D	92		65	0.58	0.89
Mixed Use Neighborhood	D	92		65	8.11	12.48
Open	B	61	Yes	0	0.00	0.92
Open	D	80	Yes	0	0.00	0.75
Roadway		98		100	13.35	13.35
Trail	B	82	Yes	100	0.07	0.07
Trail	D	89	Yes	100	0.22	0.22
Wooded	B	55	Yes	0	0.00	2.53
Wooded	B/D	77	Yes	0	0.00	1.21
Wooded	D	77	Yes	0	0.00	2.33
Total Area		59.90 ac				
Total Impervious Area		29.36 ac				
Onsite Area		9.92 ac				
Onsite Impervious Area		0.28 ac				
Percent Impervious		49 %				
Composite Curve Number		87				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	427.00	ft
Bot Elev =	426.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	2541	ft
Top Elev =	426.00	ft
Bot Elev =	368.00	ft
Height =	58	ft
Slope =	0.0228	ft/ft
Paved ? =	No	
Velocity =	2.44	ft/sec
Segment Time =	17.37	minutes

Time of Concentration =	31.12	minutes
SCS Lag Time =	18.67	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	5.41	minutes (= 0.29 * SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Open	C	74	Yes	0	0.00	1.23
Open	D	80	Yes	0	0.00	1.45
Wooded	C	70	Yes	0	0.00	0.85
Wooded	D	77	Yes	0	0.00	4.59
Total Area		8.11 ac				
Total Impervious Area		0.00 ac				
Onsite Area		8.11 ac				
Onsite Impervious Area		0.00 ac				
Percent Impervious		0 %				
Composite Curve Number		76				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	368.00	ft
Bot Elev =	363.00	ft
Height =	5	ft
Slope =	0.0500	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	9.51	minutes

Segment 2: Concentrated Flow

Length =	881	ft
Top Elev =	363.00	ft
Bot Elev =	336.00	ft
Height =	27	ft
Slope =	0.0306	ft/ft
Paved ? =	No	
Velocity =	2.82	ft/sec
Segment Time =	5.20	minutes

Segment 3: Channel Flow

Length =	249	ft
Top Elev =	336.00	ft
Bot Elev =	333.00	ft
Height =	3	ft
Slope =	0.0120	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	15.00	sf (assume 5'w x 3'h channel)
Wetted Perimeter =	11.00	lf (assume 5'w x 3'h channel)
Channel Velocity =	4.47	ft/sec
Segment Time =	0.93	minutes

Time of Concentration =	15.64	minutes
SCS Lag Time =	9.38	minutes (SCS Lag = 0.6* Tc)
Time Increment =	2.72	minutes (= 0.29*SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Crops	B	78	Yes	0	0.00	6.35
Crops	B/D	89	Yes	0	0.00	0.16
Crops	D	89	Yes	0	0.00	3.19
Mixed Use Neighborhood	B	85		65	1.18	1.82
Mixed Use Neighborhood	B/D	92		65	0.56	0.86
Mixed Use Neighborhood	C	90		65	0.68	1.04
Mixed Use Neighborhood	D	92		65	5.08	7.81
Open	A	39	Yes	0	0.00	1.44
Open	B	61	Yes	0	0.00	10.63
Open	B/D	80	Yes	0	0.00	8.78
Open	C	74	Yes	0	0.00	4.91
Open	D	80	Yes	0	0.00	20.40
Roadway		98		100	7.47	7.47
Roof	B	98	Yes	100	0.11	0.11
Roof	B/D	98	Yes	100	0.00	0.00
Roof	D	98	Yes	100	0.03	0.03
Trail	A	72	Yes	100	0.17	0.17
Trail	B	82	Yes	100	0.39	0.39
Trail	B/D	89	Yes	100	0.19	0.19
Trail	D	89	Yes	100	0.69	0.69
Wooded	A	30	Yes	0	0.00	0.00
Wooded	B	55	Yes	0	0.00	3.07
Wooded	B/D	77	Yes	0	0.00	9.47
Wooded	C	70	Yes	0	0.00	7.15
Wooded	D	77	Yes	0	0.00	12.43
Total Area		108.57 ac				
Total Impervious Area		16.56 ac				
Onsite Area		89.56 ac				
Onsite Impervious Area		1.59 ac				
Percent Impervious		15 %				
Composite Curve Number		78				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	389.00	ft
Bot Elev =	388.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	1855	ft
Top Elev =	388.00	ft
Bot Elev =	339.00	ft
Height =	49	ft
Slope =	0.0264	ft/ft
Paved ? =	No	
Velocity =	2.62	ft/sec
Segment Time =	11.79	minutes

Segment 3: Channel Flow

Length =	2366	ft
Top Elev =	339.00	ft
Bot Elev =	302.00	ft
Height =	37	ft
Slope =	0.0156	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	15.00	sf (assume 5'w x 3'h channel)
Wetted Perimeter =	11.00	lf (assume 5'w x 3'h channel)
Channel Velocity =	5.09	ft/sec
Segment Time =	7.74	minutes

Time of Concentration =	33.28	minutes
SCS Lag Time =	19.97	minutes (SCS Lag = 0.6* Tc)
Time Increment =	5.79	minutes (= 0.29*SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Business Park	A	89		85	0.01	0.01
Business Park	B	92		85	0.02	0.02
Business Park	D	95		85	0.03	0.03
Commercial	D	95		85	0.86	1.01
High Density Residential	B	85		65	46.03	70.82
High Density Residential	D	92		65	33.44	51.45
Low Density Residential	B	65		20	0.18	0.92
Low Density Residential	D	82		20	0.37	1.85
Medium Density Residential	A	54		25	0.00	0.01
Medium Density Residential	B	70		25	11.98	47.92
Medium Density Residential	D	85		25	10.74	42.98
Mixed Use Neighborhood	B	85		65	4.36	6.71
Mixed Use Neighborhood	B/D	92		65	2.15	3.31
Mixed Use Neighborhood	D	92		65	7.50	11.55
Open	A	49	Yes	0	0.00	1.90
Open	B	69	Yes	0	0.00	10.33
Open	D	84	Yes	0	0.00	11.86
Preserved Open Space	A	39		0	0.00	0.39
Preserved Open Space	B	61		0	0.00	4.48
Preserved Open Space	D	80		0	0.00	34.05
Roadway		98		100	49.05	49.05
School	B	88		72	0.34	0.47
School	D	93		72	5.12	7.11
Town Center	B	92		85	5.55	6.53
Town Center	D	95		85	1.48	1.74
Trail	A	72	Yes	100	0.02	0.02
Trail	B	82	Yes	100	0.43	0.43
Trail	D	89	Yes	100	1.93	1.93
Wooded	A	30	Yes	0	0.00	0.70
Wooded	B	55	Yes	0	0.00	4.50
Wooded	B/D	77	Yes	0	0.00	0.15
Wooded	D	77	Yes	0	0.00	50.68
Total Area		424.89 ac				
Total Impervious Area		181.60 ac				
Onsite Area		82.49 ac				
Onsite Impervious Area		2.38 ac				
Percent Impervious		43 %				
Composite Curve Number		84				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	440.00	ft
Bot Elev =	438.00	ft
Height =	2	ft
Slope =	0.0200	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.72	minutes

Segment 2: Concentrated Flow

Length =	2989	ft
Top Elev =	438.00	ft
Bot Elev =	372.00	ft
Height =	66	ft
Slope =	0.0221	ft/ft
Paved ? =	No	
Velocity =	2.40	ft/sec
Segment Time =	20.78	minutes

Segment 3: Open Water Flow

Length =	655	ft
Top Elev =	372.00	ft
Bot Elev =	372.00	ft
Segment Time =	0.00	minutes

Segment 4: Concentrated Flow

Length =	2379	ft
Top Elev =	372.00	ft
Bot Elev =	320.00	ft
Height =	52	ft
Slope =	0.0219	ft/ft
Paved ? =	No	
Velocity =	2.39	ft/sec
Segment Time =	16.62	minutes

Segment 5: Channel Flow

Length =	3730	ft
Top Elev =	320.00	ft
Bot Elev =	292.00	ft
Height =	28	ft
Slope =	0.0075	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	32.00	sf (assume 8'w x 4'h channel)
Wetted Perimeter =	16.00	lf (assume 8'w x 4'h channel)
Channel Velocity =	4.55	ft/sec
Segment Time =	13.65	minutes

Time of Concentration =	48.15	minutes
SCS Lag Time =	28.89	minutes (SCS Lag = 0.6* Tc)
Time Increment =	8.38	minutes (= 0.29*SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Trail	D	89	Yes	100	0.16	0.16
Wooded	A	30	Yes	0	0.00	0.37
Wooded	D	77	Yes	0	0.00	8.04
Total Area	8.56 ac					
Total Impervious Area	0.16 ac					
Onsite Area	8.56 ac					
Onsite Impervious Area	0.16 ac					
Percent Impervious	2 %					
Composite Curve Number	75					

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length = 100 ft
 Top Elev = 386.00 ft
 Bot Elev = 380.00 ft
 Height = 6 ft
 Slope = 0.0600 ft/ft
 Manning's n = 0.40 wooded
 P (2-year/24-hour) = 3.46 inches (Rolesville, NC)
Segment Time = 13.31 minutes

Segment 2: Concentrated Flow

Length = 599 ft
 Top Elev = 380.00 ft
 Bot Elev = 288.00 ft
 Height = 92 ft
 Slope = 0.1536 ft/ft
 Paved ? = No
 Velocity = 6.32 ft/sec
Segment Time = 1.58 minutes

Time of Concentration =	14.89	minutes
SCS Lag Time =	8.93	minutes (SCS Lag = 0.6* Tc)
Time Increment =	2.59	minutes (= 0.29*SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Open	A	39	Yes	0	0.00	0.70
Open	B	61	Yes	0	0.00	1.00
Open	D	80	Yes	0	0.00	0.06
Trail	B	82	Yes	100	0.15	0.15
Wooded	A	30	Yes	0	0.00	0.66
Wooded	B	55	Yes	0	0.00	7.85
Wooded	D	77	Yes	0	0.00	5.24
Total Area		15.67 ac				
Total Impervious Area		0.15 ac				
Onsite Area		15.67 ac				
Onsite Impervious Area		0.15 ac				
Percent Impervious		1 %				
Composite Curve Number		61				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length = 100 ft
 Top Elev = 418.00 ft
 Bot Elev = 417.00 ft
 Height = 1 ft
 Slope = 0.0100 ft/ft
 Manning's n = 0.24 dense grasses
 P (2-year/24-hour) = 3.46 inches (Rolesville, NC)
Segment Time = 18.11 minutes

Segment 2: Concentrated Flow

Length = 591 ft
 Top Elev = 417.00 ft
 Bot Elev = 338.00 ft
 Height = 79 ft
 Slope = 0.1337 ft/ft
 Paved ? = No
 Velocity = 5.90 ft/sec
Segment Time = 1.67 minutes

Segment 3: Channel Flow

Length = 285 ft
 Top Elev = 338.00 ft
 Bot Elev = 324.00 ft
 Height = 14 ft
 Slope = 0.0491 ft/ft
 Manning's n = 0.045 natural channel
 Flow Area = 10.00 sf (assume 5'w x 2'h channel)
 Wetted Perimeter = 9.00 lf (assume 5'w x 2'h channel)
 Channel Velocity = 7.87 ft/sec
Segment Time = 0.60 minutes

Time of Concentration =	20.38	minutes
SCS Lag Time =	12.23	minutes (SCS Lag = 0.6* Tc)
Time Increment =	3.55	minutes (= 0.29*SCS Lag)

Land Use	HSG	CN	Onsite	Percent Impervious (%)	Impervious Area (ac)	Area (ac)
Open	A	39	Yes	0	0.00	0.67
Open	B	61	Yes	0	0.00	1.24
Open	D	80	Yes	0	0.00	0.02
Trail	A	72	Yes	100	0.04	0.04
Trail	B	82	Yes	100	0.07	0.07
Wooded	A	30	Yes	0	0.00	0.71
Wooded	B	55	Yes	0	0.00	3.22
Wooded	D	77	Yes	0	0.00	0.26
Total Area		6.23 ac				
Total Impervious Area		0.11 ac				
Onsite Area		6.23 ac				
Onsite Impervious Area		0.11 ac				
Percent Impervious		2 %				
Composite Curve Number		53				

Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

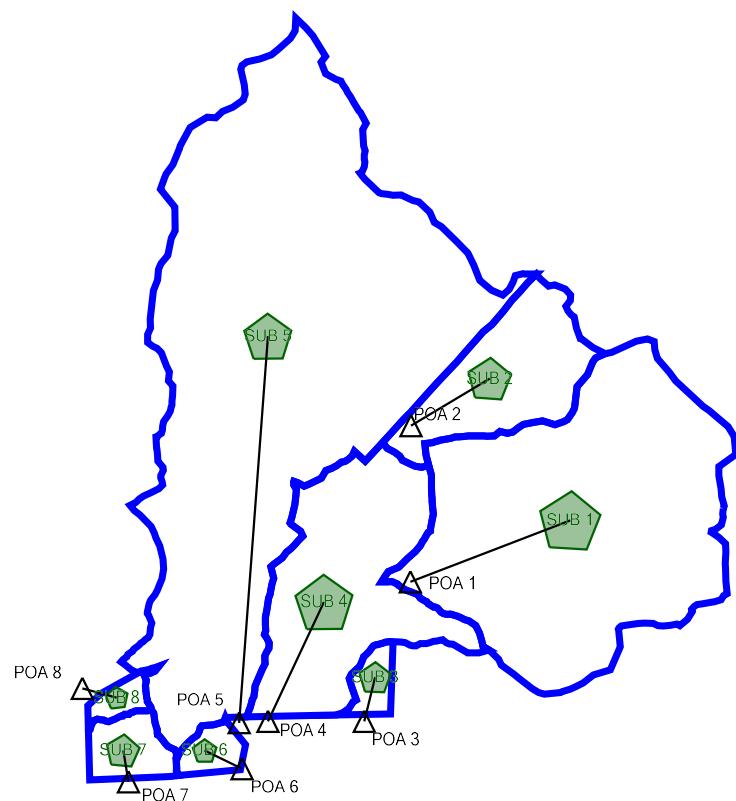
Segment 1: Overland Flow

Length =	100	ft
Top Elev =	398.00	ft
Bot Elev =	393.00	ft
Height =	5	ft
Slope =	0.0500	ft/ft
Manning's n =	0.24	dense grasses
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	9.51	minutes

Segment 2: Concentrated Flow

Length =	697	ft
Top Elev =	393.00	ft
Bot Elev =	365.00	ft
Height =	28	ft
Slope =	0.0402	ft/ft
Paved ? =	No	
Velocity =	3.23	ft/sec
Segment Time =	3.59	minutes

Time of Concentration =	13.10	minutes
SCS Lag Time =	7.86	minutes (SCS Lag = 0.6* Tc)
Time Increment =	2.28	minutes (= 0.29*SCS Lag)

**Scenario: Pre-
Development**

**FlexTable: Catchment
Table (AWH20000.ppc)**

Current Time: 0.00 min

Notes	Label	Area (User Defined) (acres)	SCS CN	Time of Concentration (min)
PRE	SUB 1	236.88	89.0	40.80
PRE	SUB 2	59.90	87.0	31.12
PRE	SUB 3	8.11	76.0	15.64
PRE	SUB 4	108.57	78.0	33.28
PRE	SUB 5	424.89	84.0	48.15
PRE	SUB 6	8.56	75.0	14.89
PRE	SUB 7	15.67	61.0	20.38
PRE	SUB 8	6.23	53.0	13.10

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
SUB 1	Pre-Dev 1 yr	1	34.657	745.00	283.5
SUB 1	Pre-Dev 10 yr	10	74.868	745.00	545.3
SUB 2	Pre-Dev 1 yr	1	8.007	739.00	77.3
SUB 2	Pre-Dev 10 yr	10	17.950	738.00	153.0
SUB 5	Pre-Dev 1 yr	1	48.954	751.00	359.7
SUB 5	Pre-Dev 10 yr	10	116.278	751.00	787.2
SUB 4	Pre-Dev 1 yr	1	9.218	741.00	80.9
SUB 4	Pre-Dev 10 yr	10	24.755	741.00	204.9
SUB 7	Pre-Dev 1 yr	1	0.405	737.00	2.4
SUB 7	Pre-Dev 10 yr	10	1.820	733.00	17.2
SUB 8	Pre-Dev 1 yr	1	0.061	754.00	0.2
SUB 8	Pre-Dev 10 yr	10	0.458	729.00	4.3
SUB 6	Pre-Dev 1 yr	1	0.618	729.00	8.3
SUB 6	Pre-Dev 10 yr	10	1.774	728.00	22.0
SUB 3	Pre-Dev 1 yr	1	0.620	730.00	8.2
SUB 3	Pre-Dev 10 yr	10	1.739	728.00	21.2

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
POA 1	Pre-Dev 1 yr	1	34.657	745.00	283.5
POA 1	Pre-Dev 10 yr	10	74.868	745.00	545.3
POA 3	Pre-Dev 1 yr	1	0.620	730.00	8.2
POA 3	Pre-Dev 10 yr	10	1.739	728.00	21.2
POA 4	Pre-Dev 1 yr	1	9.218	741.00	80.9
POA 4	Pre-Dev 10 yr	10	24.755	741.00	204.9
POA 5	Pre-Dev 1 yr	1	48.954	751.00	359.7
POA 5	Pre-Dev 10 yr	10	116.278	751.00	787.2
POA 6	Pre-Dev 1 yr	1	0.618	729.00	8.3
POA 6	Pre-Dev 10 yr	10	1.774	728.00	22.0
POA 7	Pre-Dev 1 yr	1	0.405	737.00	2.4
POA 7	Pre-Dev 10 yr	10	1.820	733.00	17.2
POA 8	Pre-Dev 1 yr	1	0.061	754.00	0.2
POA 8	Pre-Dev 10 yr	10	0.458	729.00	4.3
POA 2	Pre-Dev 1 yr	1	8.007	739.00	77.3
POA 2	Pre-Dev 10 yr	10	17.950	738.00	153.0



MCADAMS

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CLIENT

ASHTON WOODS
5711 SIX FORKS ROAD, SUITE 300
RALEIGH, NORTH CAROLINA 27609



**THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA**

REVISIONS

NO.	DATE
1	04.09.2020 REV PER TOWN COMMENTS

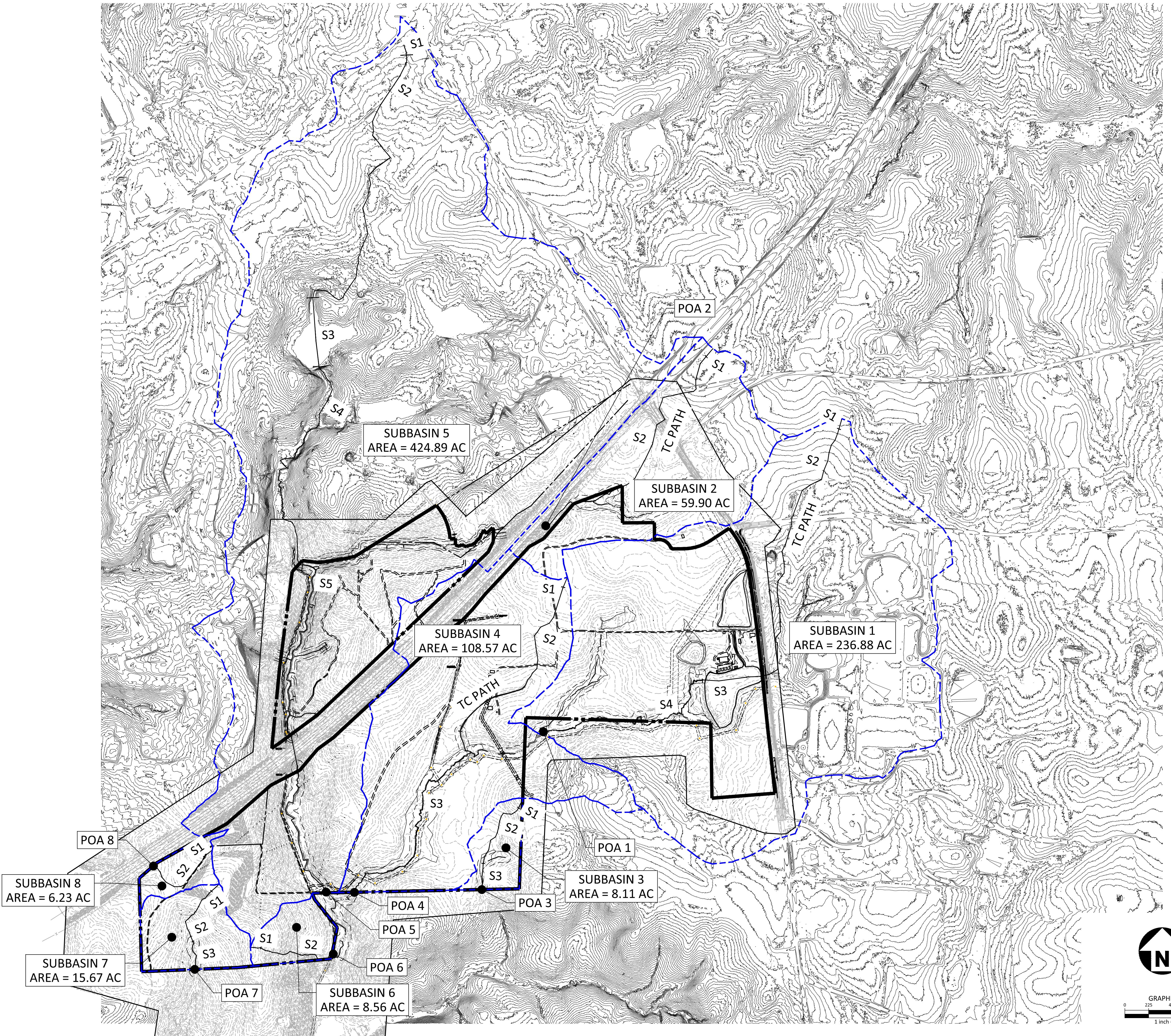
PLAN INFORMATION

PROJECT NO.	AWH-20000
FILENAME	AWH-20000.PRE
CHECKED BY	DCW
DRAWN BY	LK
SCALE	1" = 450'
DATE	06.19.2020

SHEET

PRE DEVELOPMENT
HYDROLOGY MAP

PRE



*POST-DEVELOPMENT
HYDROLOGIC CALCULATIONS*

The Point
AWH-20000

POST-DEVELOPMENT HYDROLOGY

Subbasin Sub 1 to SCM A

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: **SUB 1 TO SCM A**

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	98064	0	80685	23973	11367	4630
B/D	0	0	0	0	0	0
C	0	0	0	0	0	0
D	49971	0	48828	12751	0	9

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	0	84208	0	23114
B/D	0	0	0	0	0
C	0	0	0	0	0
D	0	0	6862	0	0

VI. OFFSITE AREAS - ZONING

	90% impervious	30% impervious	25% impervious	20% impervious	85% impervious	65% impervious	85% impervious	0% impervious	85% impervious	72% impervious
HSG	Right Of Way	High Density Residential	Medium Density Residential	Low Density Residential	Commercial	Mixed Use Neighborhood	Business Park	Preserved Open Space	Town Center	School
A	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	18111	0	0	0	0
B/D	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0
D	186	0	0	0	0	78952	0	0	0	0

THE POINTE
AWH20000

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 1 to SCM A

C. JAMES, PE
11/24/2020

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	0	0	0	0
SingleFamily40	56,464	39,525	5,646	11,293
SingleFamily50	0	0	0	0
SingleFamily60	11,557	8,090	1,156	2,311
Totals	68,021	47,614	6,802	13,604

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc = 12.44 acres
541712 sf

Composite SCS CN = 85
Total Impervious Area = 297515 sf

% Impervious = 54.9%

IX. TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

THE POINT
AWH2000C

POST-DEVELOPMENT HYDROLOGY

Subbasin Sub 1 to SCM C

C. JAMES, PE
11/24/2020

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: SUB 1 TO SCM C

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	61769	0	73235	21972	1330	804
B/D	0	0	0	0	0	0
C	0	0	0	0	0	0
D	51459	0	40559	12919	13788	88

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	90183	141800	0	43514
B/D	0	0	0	0	0
C	0	0	0	0	0
D	0	79639	39449	0	10628

VI. OFFSITE AREAS - ZONING

THE POINTE
AWH20000

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 1 to SCM C

C. JAMES, PE
11/24/2020

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	109,806	76,864	10,981	21,961
SingleFamily40	112,374	78,662	11,237	22,475
SingleFamily50	0	0	0	0
SingleFamily60	27,071	18,950	2,707	5,414
Totals	249,251	174,476	24,925	49,850

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc = 15.68 acres
683134 sf

Composite SCS CN = 86
Total Impervious Area = 397936 sf

% Impervious = 58.3%

IX. TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

THE POINT
AWH2000C

POST-DEVELOPMENT HYDROLOGY

C. JAMES, PE
11/24/2020

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: SUB 1 TO SCM D

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	70779	619	71986	24952	19528	0
B/D	3050	0	2654	905	85	0
C	0	0	0	0	0	0
D	487	0	383	379	0	0

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	0	0	0	362575
B/D	0	0	0	0	17129
C	0	0	0	0	0
D	0	0	0	0	13

VI. OFFSITE AREAS - ZONING

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 1 to SCM D

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	0	0	0	0
SingleFamily40	0	0	0	0
SingleFamily50	0	0	0	0
SingleFamily60	189,859	132,901	18,986	37,972
Totals	189,859	132,901	18,986	37,972

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc = 13.21 acres
575524 sf

Composite SCS CN = 81
Total Impervious Area = **291118** sf

% Impervious = 50.6%

IX. TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

THE POINT
AWH2000C

POST-DEVELOPMENT HYDROLOGY

Subbasin Sub 1 to SCM F

C. JAMES, PE
11/24/2020

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: SUB 1 TO SCM E

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	46811	0	59630	16037	8728	1677
B/D	5822	0	3836	1966	0	0
C	0	0	0	0	0	0
D	44008	0	60659	16233	10349	1

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	57697	98197	0	86974
B/D	0	0	1650	0	22691
C	0	0	0	0	0
D	0	49507	101286	0	55579

VI. OFFSITE AREAS - ZONING

THE POINTE
AWH20000

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 1 to SCM E

C. JAMES, PE
11/24/2020

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	69,318	48,523	6,932	13,864
SingleFamily40	124,702	87,292	12,470	24,940
SingleFamily50	0	0	0	0
SingleFamily60	82,622	57,836	8,262	16,524
Totals	276,643	193,650	27,664	55,329

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc = 17.20 acres
749339 sf

Composite SCS CN = 87
Total Impervious Area = **435004** sf

% Impervious = 58.1%

IX. TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

THE POINT
AWH2000C

POST-DEVELOPMENT HYDROLOGY

Subbasin Sub 4 to SCM F

C. JAMES, PE
11/24/2020

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: SUB 4 TO SCM F

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	61623	460	49590	12732	0	4318
B/D	140237	0	29204	11799	47	0
C	0	0	0	0	0	0
D	112800	0	33430	8911	16065	0

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	90465	85971	0	0
B/D	0	25633	12370	0	0
C	0	0	0	0	0
D	0	11973	73531	0	26072

VI. OFFSITE AREAS - ZONING

THE POINTE
AWH20000

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 4 to SCM F

C. JAMES, PE
11/24/2020

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	82,811	57,968	8,281	16,562
SingleFamily40	106,560	74,592	10,656	21,312
SingleFamily50	0	0	0	0
SingleFamily60	13,036	9,125	1,304	2,607
Totals	202,407	141,685	20,241	40,481

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc = 18.53 acres
807229 sf

Composite SCS CN = 85
Total Impervious Area = 348073 sf

% Impervious = 43.1%

IX. TIME OF CONCENTRATION

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

THE POINTE
AWH20000

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 1 BYPASS

C. JAMES, PE
11/24/2020

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: **SUB 1 BYPASS**

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	626354	151729	7629	9420	5386	110741
B/D	53357	224330	0	0	1148	0
C	0	1512	0	0	0	0
D	344983	18777	14	54	295509	11559

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	0	0	0	13066
B/D	0	0	0	0	0
C	0	0	0	0	0
D	0	0	0	0	2271

VI. OFFSITE AREAS - ZONING

	90% impervious	30% impervious	25% impervious	20% impervious	85% impervious	65% impervious	85% impervious	0% impervious	85% impervious	72% impervious
HSG	Right of Way	High Density Residential	Medium Density Residential	Low Density Residential	Commercial	Mixed Use Neighborhood	Business Park	Preserved Open Space	Town Center	School
A	0	0	0	0	0	0	0	0	0	0
B	180252	0	49735	0	0	602571	0	0	0	780297
B/D	16957	0	0	0	0	179660	0	0	0	369944
C	0	0	0	0	0	77938	0	0	0	0
D	153627	0	3316	985806	0	631461	0	0	0	2652145

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	0	0	0	0
SingleFamily40	0	0	0	0
SingleFamily50	0	0	0	0
SingleFamily60	7,668	5,368	767	1,534
Totals	7,668	5,368	767	1,534

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc =	196.55	acres
	8561548	sf
Composite SCS CN =	87	
Total Impervious Area =	4258240	sf
% Impervious =	49.7%	

IX. TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	426.00	ft
Bot Elev =	425.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	2645	ft
Top Elev =	425.00	ft
Bot Elev =	374.00	ft
Height =	51	ft
Slope =	0.0193	ft/ft
Paved ? =	No	
Velocity =	2.24	ft/sec
Segment Time =	19.68	minutes

Segment 3: Open Water Flow

Length =	580	ft
Top Elev =	374.00	ft
Bot Elev =	372.00	ft
Segment Time =	0.00	minutes

Segment 4: Channel Flow

Length =	2088	ft
Top Elev =	372.00	ft
Bot Elev =	344.00	ft
Height =	28	ft
Slope =	0.0134	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	15.00	sf (assume 5'w x 3'h channel)
Wetted Perimeter =	11.00	ft (assume 5'w x 3'h channel)
Channel Velocity =	4.72	ft/sec
Segment Time =	7.38	minutes

Time of Concentration =	40.80	minutes
SCS Lag Time =	24.48	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	7.10	minutes (= 0.29 * SCS Lag)

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 2 BYPASS

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: **SUB 2 BYPASS**

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	0	0	0	0	0	0
B	34151	24838	0	7109	0	23598
B/D	0	52628	0	0	0	0
C	0	0	0	0	0	0
D	22430	26607	0	4410	0	4671

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	17	0	0	0
B/D	0	0	0	0	0
C	0	0	0	0	0
D	0	0	0	0	0

VI. OFFSITE AREAS - ZONING

	90% impervious	30% impervious	25% impervious	20% impervious	85% impervious	65% impervious	85% impervious	0% impervious	85% impervious	72% impervious
HSG	Right of Way	High Density Residential	Medium Density Residential	Low Density Residential	Commercial	Mixed Use Neighborhood	Business Park	Preserved Open Space	Town Center	School
A	0	0	0	0	0	0	0	0	0	0
B	100879	0	0	0	0	230704	0	0	0	0
B/D	37900	0	0	0	0	38861	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0
D	442930	0	0	782428	0	543504	0	0	0	0

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 2 BYPASS

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	11	8	1	2
SingleFamily40	0	0	0	0
SingleFamily50	0	0	0	0
SingleFamily60	0	0	0	0
Totals	11	8	1	2

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc =	54.58	acres
	2377665	sf
Composite SCS CN =	87	
Total Impervious Area =	1220049	sf
% Impervious =	51.3%	

IX. TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	427.00	ft
Bot Elev =	426.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	2541	ft
Top Elev =	426.00	ft
Bot Elev =	368.00	ft
Height =	58	ft
Slope =	0.0228	ft/ft
Paved ? =	No	
Velocity =	2.44	ft/sec
Segment Time =	17.37	minutes

Time of Concentration =	31.12	minutes
SCS Lag Time =	18.67	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	5.41	minutes (= 0.29 * SCS Lag)

POST-DEVELOPMENT HYDROLOGY
Subbasin Sub 4 BYPASS

I. ONSITE SCS CURVE NUMBERS - LAND COVER

HSG	Open	Wooded	Roads	Sidewalk	Pond	Crops
A	39	30	98	98	100	67
B	61	55	98	98	100	78
B/D	80	77	98	98	100	89
C	74	70	98	98	100	85
D	80	77	98	98	100	89

BasinID: **SUB 4 BYPASS**

II. ONSITE SCS CURVE NUMBERS - LOTS

HSG	22' Townhome	39' Single Family	40' Single Family	50' Single Family	60' Single Family
A	93	77	76	74	69
B	95	85	84	83	80
B/D	96	92	91	91	89
C	96	90	89	88	86
D	96	92	91	91	89

III. OFFSITE SCS CURVE NUMBERS - ZONING

HSG	Right-Of-Way	Zoning - High Res (1/3 acre)	Zoning - Med Res (1/2 acre)	Zoning - Low Res (1 acre)	Zoning - Commercial	Zoning - MU Neighborhood	Zoning - Business Park	Zoning - Preserved Open	Town Center	School
A	83	57	54	51	89	72	89	39	89	75
B	89	72	70	68	92	85	92	61	92	88
B/D	93	86	85	84	95	92	95	80	95	93
C	91	82	80	79	94	90	94	74	94	91
D	93	86	85	84	95	92	95	80	95	93

IV. ONSITE AREAS - LAND COVER

HSG	Open	Onsite Wooded	Onsite Roads	Onsite Sidewalk	Pond	Onsite Crops
A	62610	37	0	7389	0	0
B	252717	17182	0	9572	0	2680
B/D	166287	384679	0	4191	0	0
C	213969	311393	0	0	0	0
D	710741	360932	4415	20547	0	0

V. ONSITE AREAS - LOTS

HSG	Townhome22	SingleFamily39	SingleFamily40	SingleFamily50	SingleFamily60
A	0	0	0	0	0
B	0	0	0	0	0
B/D	0	0	0	0	0
C	0	0	0	0	0
D	0	0	0	0	732

VI. OFFSITE AREAS - ZONING

	90% impervious	30% impervious	25% impervious	20% impervious	85% impervious	65% impervious	85% impervious	0% impervious	85% impervious	72% impervious
HSG	Right Of Way	High Density Residential	Medium Density Residential	Low Density Residential	Commercial	Mixed Use Neighborhood	Business Park	Preserved Open Space	Town Center	School
A	0	0	0	0	0	0	0	0	0	0
B	89968	0	0	0	0	79292	0	0	0	0
B/D	35340	0	0	0	0	37595	0	0	0	0
C	0	0	0	0	0	45463	0	0	0	0
D	206687	0	0	0	0	340417	0	0	0	0

VII. LOT BREAKDOWN

Contributing Area	Total Impervious [sf]	Roof Area [sf]	Sidewalk Area [sf]	Driveway Area [sf]
Townhome22	0	0	0	0
SingleFamily39	0	0	0	0
SingleFamily40	0	0	0	0
SingleFamily50	0	0	0	0
SingleFamily60	366	256	37	73
Totals	366	256	37	73

VIII. TOTAL DRAINAGE AREA RESULT

Total Area per GIS Calc =	77.25	acres
	3364834	sf
Composite SCS CN =	79	
Total Impervious Area =	672073	sf
% Impervious =	20.0%	

IX. TIME OF CONCENTRATION

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	389.00	ft
Bot Elev =	388.00	ft
Height =	1	ft
Slope =	0.0100	ft/ft
Manning's n =	0.17	cultivated soils, residue cover
P (2-year/24-hour) =	3.46	inches (Rolesville, NC)
Segment Time =	13.74	minutes

Segment 2: Concentrated Flow

Length =	1855	ft
Top Elev =	388.00	ft
Bot Elev =	339.00	ft
Height =	49	ft
Slope =	0.0264	ft/ft
Paved ? =	No	
Velocity =	2.62	ft/sec
Segment Time =	11.79	minutes

Segment 3: Channel Flow

Length =	2366	ft
Top Elev =	339.00	ft
Bot Elev =	302.00	ft
Height =	37	ft
Slope =	0.0156	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	15.00	sf (assume 5'w x 3'h channel)
Wetted Perimeter =	11.00	ft (assume 5'w x 3'h channel)
Channel Velocity =	5.09	ft/sec
Segment Time =	7.74	minutes

Time of Concentration =	33.28	minutes
SCS Lag Time =	19.97	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	5.79	minutes (= 0.29 * SCS Lag)

REACH DATA**Reach 1 - POA 1 to POA 4**

Length = 2988 ft
Top Elev = 344.00 ft
Bot Elev = 302.00 ft
Height = 42 ft
Slope = 0.0141 ft/ft
Manning's n = 0.045 natural channel
Flow Area = 10.00 sf (assume 5'w x 2'h channel)
Wetted Perimeter = 9.00 lf (assume 5'w x 2'h channel)
Channel Velocity = 4.21 ft/sec
Reach Travel Time = 11.83 minutes

Reach 2 - SCM A to POA 1**Segment 1: Concentrated Flow**

Length = 647 ft
Top Elev = 377.00 ft
Bot Elev = 368.00 ft
Height = 9 ft
Slope = 0.0139 ft/ft
Paved ? = No
Velocity = 1.90 ft/sec
Segment Time = 5.67 minutes

Segment 2: Channel Flow

Length = 2038 ft
Top Elev = 368.00 ft
Bot Elev = 344.00 ft
Height = 24 ft
Slope = 0.0118 ft/ft
Manning's n = 0.045 natural channel
Flow Area = 12.00 sf (assume 6'w x 2'h channel)
Wetted Perimeter = 10.00 lf (assume 6'w x 2'h channel)
Channel Velocity = 4.06 ft/sec
Reach Travel Time = 8.37 minutes

Total Reach Travel Time = 14.04

Reach 3 - SCM C to POA 1**Segment 1: Concentrated Flow**

Length = 83 ft
Top Elev = 370.00 ft
Bot Elev = 366.00 ft
Height = 4 ft
Slope = 0.0482 ft/ft
Paved ? = No
Velocity = 3.54 ft/sec
Segment Time = 0.39 minutes

Segment 2: Channel Flow

Length = 1220 ft
Top Elev = 366.00 ft
Bot Elev = 344.00 ft
Height = 22 ft
Slope = 0.0180 ft/ft
Manning's n = 0.045 natural channel
Flow Area = 8.00 sf (assume 4'w x 2'h channel)
Wetted Perimeter = 8.00 lf (assume 4'w x 2'h channel)
Channel Velocity = 4.45 ft/sec
Reach Travel Time = 4.57 minutes

Total Reach Travel Time = 4.96

Reach 4 - SCM F to POA 4**Segment 1: Concentrated Flow**

Length = 77 ft
Top Elev = 339.00 ft
Bot Elev = 336.00 ft
Height = 3 ft
Slope = 0.0390 ft/ft
Paved ? = No
Velocity = 3.18 ft/sec
Segment Time = 0.40 minutes

Segment 2: Channel Flow

Length = 2292 ft
Top Elev = 336.00 ft
Bot Elev = 302.00 ft
Height = 34 ft
Slope = 0.0148 ft/ft
Manning's n = 0.045 natural channel
Flow Area = 10.00 sf (assume 5'w x 2'h channel)
Wetted Perimeter = 9.00 lf (assume 5'w x 2'h channel)
Channel Velocity = 4.33 ft/sec
Reach Travel Time = 8.83 minutes

Total Reach Travel Time = 9.23

NUTRIENT INPUT SUMMARY

Land Use	Treated Area (sf)	Bypassed Area (sf)
Impervious	1,196,285	113,500
Pond	81,285	303,191
Open	3,220,965	6,436,387
Wooded	1,698	1,847,629
Total	4,500,233	8,700,707

SUB 1 TO SCM A	SUB 1 BYPASS
SUB 1 TO SCM C	SUB 2 BYPASS
SUB 1 TO SCM D	SUB 4 BYPASS
SUB 1 TO SCM E	
SUB 4 TO SCM F	

Total Lot Area =	2268855	sf
Total Treated Lot Area =	2252752	sf
Total Untreated Lot Area =	16103	sf
Total Lot Impervious =	0	sf
Total Lot Open =	2268855	sf

Total Area	15659221 sf
Right of Way	2458281 sf
Nitrogen Area	13200940 sf
Treated+Untreated Total	13200940 sf

TREATED AREA BREAKDOWN

	ONSITE ROADS	ONSITE SIDEWALK	RIGHT OF WAY	POND	ONSITE WOODED	ONSITE CROPS	OPEN	SINGLEFAMILY39	SINGLEFAMILY40	SINGLEFAMILY60
SCM A	307853	86198	557	11367	0	4640	296071	0	91070	23114
SCM C	227589	69781	0	15117	0	892	174997	260004	181249	54142
SCM D	75024	26235	0	19613	1238	0	74316	0	0	742292
SCM E	124125	50470	0	19077	0	1678	96642	107204	302418	165244
SCM F	174858	54152	0	16112	460	4318	314660	128071	171872	26072

BYPASSED AREA BREAKDOWN

	ONSITE ROADS	ONSITE SIDEWALK	RIGHT OF WAY	POND	ONSITE WOODED	ONSITE CROPS	OPEN	ONSITE TRAIL	SINGLEFAMILY39	SINGLEFAMILY40	SINGLEFAMILY60
SUB 1 BYPASS	15273	37788	1035551	303191	548078	233042	2675743	0	0	0	15337
SUB 2 BYPASS	0	11520	1125518	0	208146	28269	147311	0	34	0	0
SUB 4 BYPASS	4415	41698	296655	0	1091405	2680	3333240	2806	0	0	732

Lot Impervious Assumptions

	<i>Max. Imp. Assumption</i>	<i>Avg Lot Dimensions</i>	<i>Avg Lot Area</i>	<i>% Impervious</i>
22' Townhome	1500	22 x 75	1650	91%
39' Single Family	2900	39 x 115	4485	65%
40' Single Family	3100	40 x 125	5000	62%
50' Single Family	3600	50 x 123	6150	59%
60' Single Family	4200	60 x 140	8400	50%

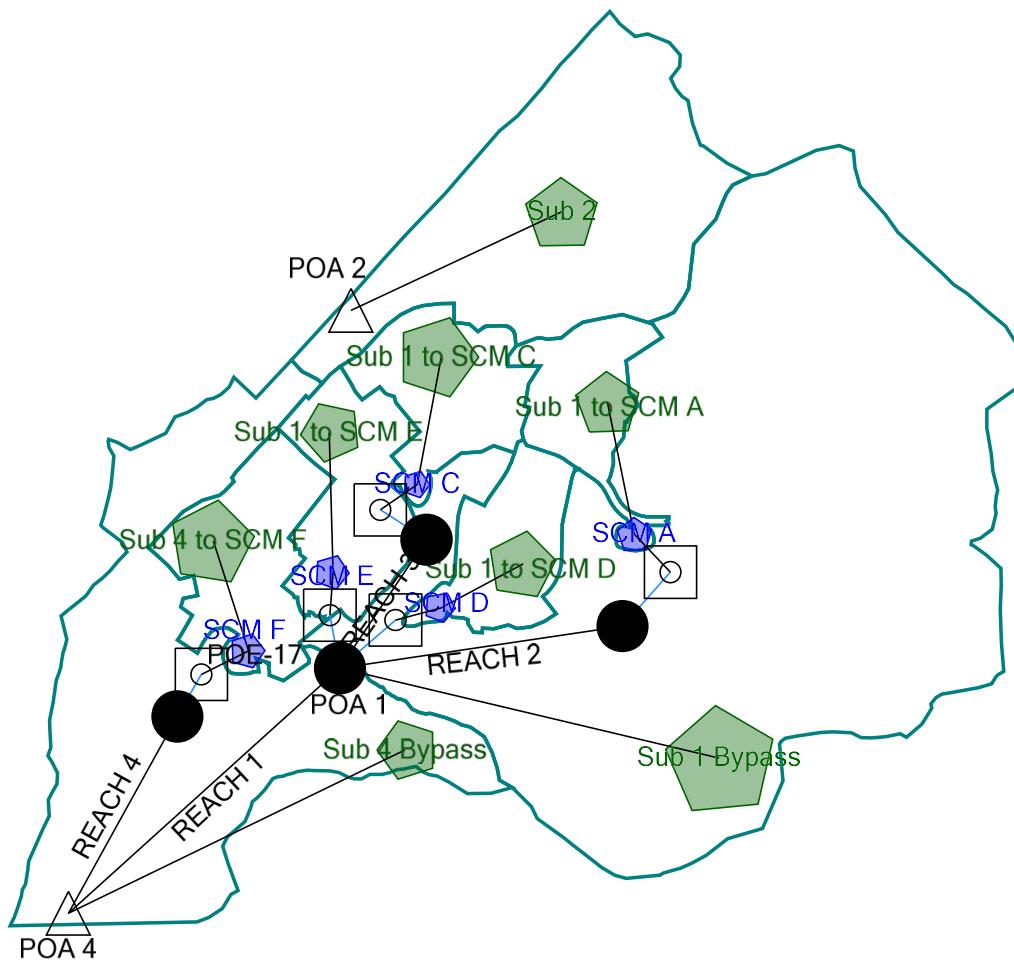
Curve Number Assumptions (Composite)

	<i>HSG A</i>	<i>HSG B</i>	<i>HSG C</i>	<i>HSG D</i>
22' Townhome	93	95	96	96
39' Single Family	77	85	90	92
40' Single Family	76	84	89	91
50' Single Family	74	83	88	91
60' Single Family	69	80	86	89

Lot Breakdown Assumptions

	<i>Roof</i>	<i>Sidewalk</i>	<i>Driveway</i>
22' Townhome	70%	10%	20%
39' Single Family	70%	10%	20%
40' Single Family	70%	10%	20%
50' Single Family	70%	10%	20%
60' Single Family	70%	10%	20%

**Scenario: Post-
Development**



**FlexTable: Catchment
Table (AWH20000-
CDPackage1.ppc)**

Current Time: 0.00 min

Label	Area (acres)	SCS CN	Time of Concentration (min)	Notes
Sub 2	54.58	87	31.12	POST
Sub 1 Bypass	196.55	87	40.80	POST
Sub 1 to SCM A	12.44	85	5.00	POST
Sub 1 to SCM D	13.21	81	5.00	POST
Sub 1 to SCM C	15.68	86	5.00	POST
Sub 1 to SCM E	17.20	87	5.00	POST
Sub 4 to SCM F	23.05	89	5.00	POST
Sub 4 Bypass	77.25	79	33.28	POST

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
Sub 2	Post-Dev 1 yr	1	7.297	739.00	70.4
Sub 2	Post-Dev 10 yr	10	16.357	738.00	139.4
Sub 1 Bypass	Post-Dev 1 yr	1	26.207	745.00	214.0
Sub 1 Bypass	Post-Dev 10 yr	10	58.763	745.00	431.3
Sub 1 to SCM A	Post-Dev 1 yr	1	1.523	721.00	32.8
Sub 1 to SCM A	Post-Dev 10 yr	10	3.543	721.00	64.3
Sub 1 to SCM D	Post-Dev 1 yr	1	1.327	722.00	28.0
Sub 1 to SCM D	Post-Dev 10 yr	10	3.341	721.00	61.0
Sub 1 to SCM C	Post-Dev 1 yr	1	2.014	721.00	43.5
Sub 1 to SCM C	Post-Dev 10 yr	10	4.598	721.00	83.2
Sub 1 to SCM E	Post-Dev 1 yr	1	2.316	721.00	50.1
Sub 1 to SCM E	Post-Dev 10 yr	10	5.189	721.00	93.5
Sub 4 to SCM F	Post-Dev 1 yr	1	3.403	721.00	73.6
Sub 4 to SCM F	Post-Dev 10 yr	10	7.347	721.00	131.2
Sub 4 Bypass	Post-Dev 1 yr	1	6.923	741.00	61.4
Sub 4 Bypass	Post-Dev 10 yr	10	18.194	741.00	150.8

Node Summary

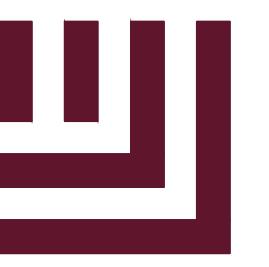
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)
POA 4	Post-Dev 1 yr	1	39.140	757.00	289.1
POA 4	Post-Dev 10 yr	10	95.810	754.00	653.6
POA 2	Post-Dev 1 yr	1	7.297	739.00	70.4
POA 2	Post-Dev 10 yr	10	16.357	738.00	139.4
	Post-Dev 1 yr	1	0.885	754.00	3.9
	Post-Dev 10 yr	10	2.884	730.00	21.6
	Post-Dev 1 yr	1	1.156	752.00	8.3
	Post-Dev 10 yr	10	3.731	728.00	37.5
	Post-Dev 1 yr	1	2.479	728.00	33.1
	Post-Dev 10 yr	10	6.402	725.00	97.2
POA 1	Post-Dev 1 yr	1	29.886	746.00	227.0
POA 1	Post-Dev 10 yr	10	71.525	745.00	506.3

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
SCM A (IN)	Post-Dev 1 yr	1	1.523	721.00	32.8	(N/A)	(N/A)
SCM A (OUT)	Post-Dev 1 yr	1	0.885	754.00	3.9	382.51	0.812
SCM A (IN)	Post-Dev 10 yr	10	3.543	721.00	64.3	(N/A)	(N/A)
SCM A (OUT)	Post-Dev 10 yr	10	2.884	730.00	21.6	384.13	1.464
SCM D (IN)	Post-Dev 1 yr	1	1.327	722.00	28.0	(N/A)	(N/A)
SCM D (OUT)	Post-Dev 1 yr	1	0.391	1,083.00	0.5	355.83	0.967

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
SCM D (IN)	Post-Dev 10 yr	10	3.341	721.00	61.0	(N/A)	(N/A)
SCM D (OUT)	Post-Dev 10 yr	10	2.062	787.00	2.5	357.53	2.041
SCM C (IN)	Post-Dev 1 yr	1	2.014	721.00	43.5	(N/A)	(N/A)
SCM C (OUT)	Post-Dev 1 yr	1	1.156	752.00	8.3	378.55	0.985
SCM C (IN)	Post-Dev 10 yr	10	4.598	721.00	83.2	(N/A)	(N/A)
SCM C (OUT)	Post-Dev 10 yr	10	3.731	728.00	37.5	379.95	1.625
SCM E (IN)	Post-Dev 1 yr	1	2.316	721.00	50.1	(N/A)	(N/A)
SCM E (OUT)	Post-Dev 1 yr	1	1.259	754.00	6.0	357.39	1.280
SCM E (IN)	Post-Dev 10 yr	10	5.189	721.00	93.5	(N/A)	(N/A)
SCM E (OUT)	Post-Dev 10 yr	10	4.108	752.00	20.5	359.05	2.358
SCM F (IN)	Post-Dev 1 yr	1	3.403	721.00	73.6	(N/A)	(N/A)
SCM F (OUT)	Post-Dev 1 yr	1	2.479	728.00	33.1	347.19	1.334
SCM F (IN)	Post-Dev 10 yr	10	7.347	721.00	131.2	(N/A)	(N/A)
SCM F (OUT)	Post-Dev 10 yr	10	6.402	725.00	97.2	348.14	1.806



MCADAMS

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PHONE: 919.232.3695
CONTACT: BOB MISHLER



ASHTON WOODS™

**THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA**

REVISIONS

- | | |
|-----|---------------------------------------|
| NO. | DATE |
| 1 | 04.09.2020 REV PER TOWN COMMENTS |
| 2 | 06.19.2020 REV PER MUNICIPAL COMMENTS |
| 3 | 08.21.2020 REV PER MUNICIPAL COMMENTS |

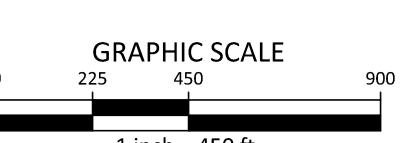
PLAN INFORMATION

PROJECT NO. AWH-20000
FILENAME AWH-20000 POST
CHECKED BY DCW
DRAWN BY CJ
SCALE 1" = 450'
DATE 11.25.2020

SHEET

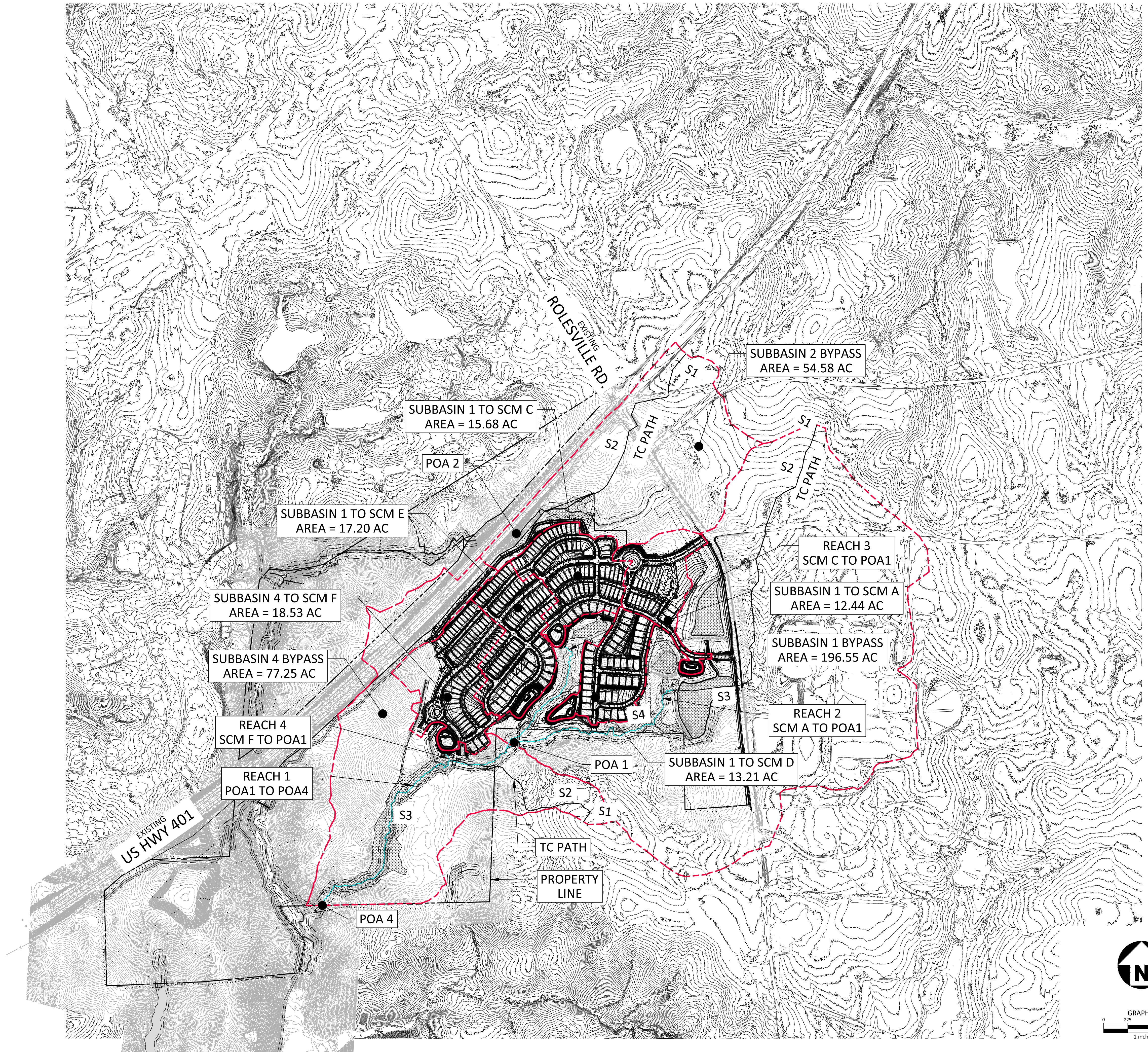
POST DEVELOPMENT
HYDROLOGY MAP

POST



0 225 450 675 900

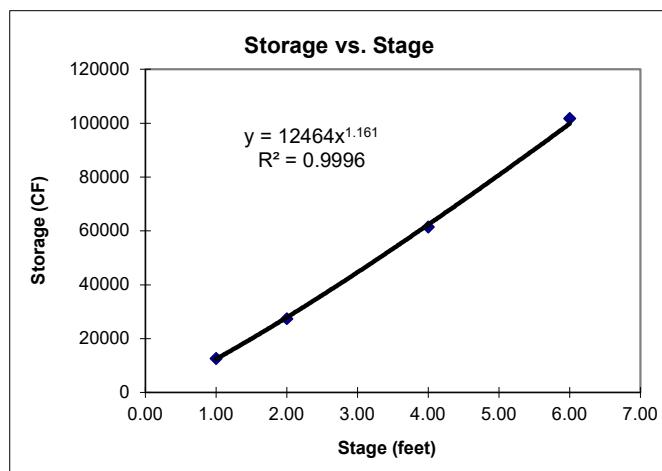
1 inch = 450 ft.



STORMWATER CONTROL MEASURE 'A'
DESIGN CALCULATIONS

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
380.00	0.00	11,282				
381.00	1.00	14,008	12645	12645	12645	1.01
382.00	2.00	15,456	14732	14732	27377	1.97
384.00	4.00	18,521	16989	33977	61354	3.95
386.00	6.00	21,813	20167	40334	101688	6.10

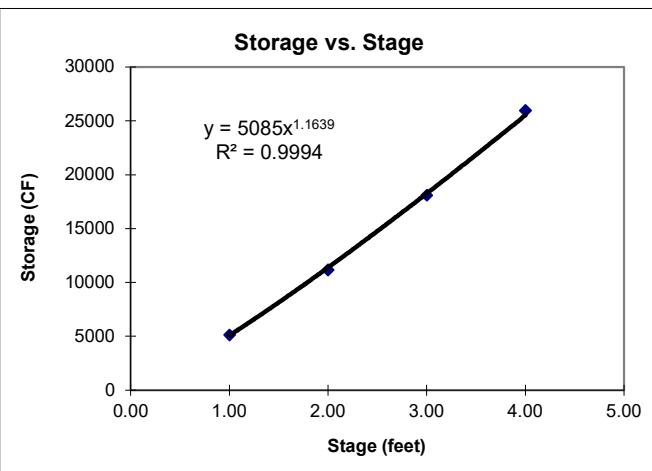


$$\begin{array}{ll} K_s = & 12464 \\ b = & 1.1610 \end{array}$$

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
375.00	-1.00	3,868				
376.00	0.00	4,711				Sediment Storage
377.00	1.00	5,579	5145	5145	5145	1.01
378.00	2.00	6,472	6026	6026	11171	1.97
379.00	3.00	7,391	6932	6932	18102	2.98
380.00	4.00	8,334	7863	7863	25965	4.06

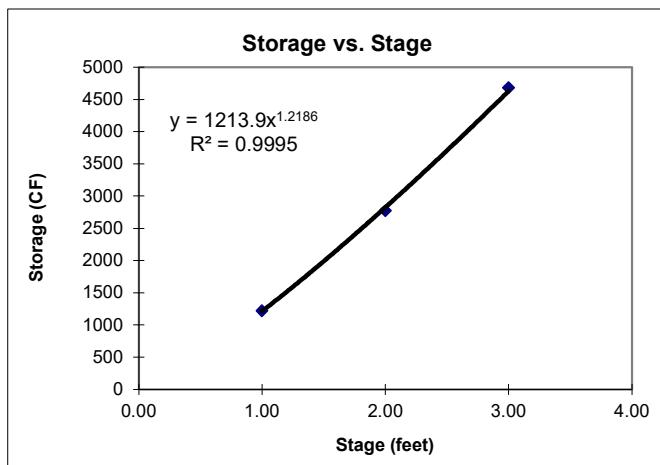
*surface area and volume used for avg. depth calculation



$K_s = 5085$ $b = 1.1639$

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
376.00	-1.00	770				
377.00	0.00	1,063				Sediment Storage
378.00	1.00	1,381	1222	1222	1222	1.01
379.00	2.00	1,724	1553	1553	2775	1.97
380.00	3.00	2,093	1909	1909	4683	3.03



$K_s =$	1213.9
$b =$	1.2186

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool=	25,965	cf
Volume of Forebay below Normal Pool=	4,683	cf
Total Volume Below Normal Pool =	30,648	cf
Total Volume Above Normal Pool=	101,688	cf
Total Volume of Facility =	132,336	cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume =	25,965	cf
Provided Forebay Volume =	4,683	cf
Provided Forebay Volume % =	18%	

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool =	25,965	cf
Main Pool Area at Normal Pool =	8,334	sf
Average Depth =	3.12	ft

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond = 12.44 acres
Total impervious area to pond = 6.83 acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **12.44** acres @ **54.9%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = **3.12**

	3.0	3.12	4.0
Lower Boundary =>	50.0	1.79	1.51
Site % impervious =>	54.9	1.94	1.64
Upper Boundary =>	60.0	2.09	1.77

Therefore, SA/DA required = **1.90**

Surface area required for main pool at normal pool = 10,309 ft²
= 0.24 acres

Surface area provided for total normal pool = 11,282 ft²

Surface area estimate for main pool at normal pool = 8,334 ft²

DETERMINATION OF WATER QUALITY VOLUME

$$WQ_V = (P)(R_V)(A)/12$$

where,

WQ_V = water quality volume (in acre-ft)

$R_V = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	12.44	acres
Impervious area =	6.83	acres
Percent impervious cover, I =	54.9	%
Rainfall, P =	1.00	inches

Calculated values:

$R_V =$	0.54	
$WQ_V =$	0.56	acre-ft
=	24571	cf.

ASSOCIATED DEPTH IN POND

$$WQ_V = 24571 \text{ cf.}$$

Stage / Storage Data:

$K_s =$	12464	
$b =$	1.161	
$Z_o =$	380.00	
Volume in 1" rainfall =	24571	cf.

Calculated values:

Depth of WQv in Basin =	1.79	ft
=	21.53	inches
Elevation =	381.79	ft

DRAWDOWN ORIFICE DESIGN

D orifice =	2.25 inch
# orifices =	1
Ks =	12464
b =	1.1610
C _d orifice =	0.60
Normal Pool Elevation =	380.00 feet
Volume @ Normal Pool =	0 cf
Orifice Invert =	380.00 feet
WSEL @ 1" Runoff Volume =	381.79 feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
381.79	24571	0.173			
381.64	22128	0.165	0.169	2443	14447
381.48	19723	0.157	0.161	2406	14961
381.33	17357	0.148	0.152	2366	15555
381.18	15035	0.138	0.143	2322	16255
381.02	12763	0.128	0.133	2273	17099
380.87	10545	0.117	0.122	2218	18146
380.71	8390	0.104	0.110	2155	19504
380.56	6310	0.090	0.097	2080	21378
380.40	4323	0.074	0.082	1988	24250
380.25	2457	0.052	0.063	1865	29704

Drawdown Time =	2.21 days
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By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.567 feet
Orifice composite loss coefficient =	0.600
Cross-sectional area of siphon =	0.028 sf

Q = 0.1001 cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.84 days
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Subsection: Elevation-Area Volume Curve

Label: SCM A

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ac-ft)	Volume (Total) (ac-ft)
380.00	0.0	11,282	0	0.000	0.000
381.00	0.0	14,008	37,861	0.290	0.290
382.00	0.0	15,456	44,178	0.338	0.628
383.00	0.0	16,960	48,607	0.372	1.000
384.00	0.0	18,521	53,204	0.407	1.407
385.00	0.0	20,139	57,973	0.444	1.851
386.00	0.0	21,813	62,911	0.481	2.332



Subsection: Outlet Input Data

Label: SCMA

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	380.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	386.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice 1yr	Forward	Culvert	382.00	386.00
Inlet Box	Riser	Forward	Culvert	383.75	386.00
Orifice-Circular	WQOrifice	Forward	Culvert	380.00	386.00
Culvert-Circular	Culvert	Forward	TW	379.00	386.00
Tailwater Settings	Tailwater			(N/A)	(N/A)



Subsection: Outlet Input Data

Label: SCMA

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Culvert
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	30.00 in
Length	46.40 ft
Length (Computed Barrel)	46.41 ft
Slope (Computed)	0.022 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0
Kb	0
Kr	0
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	381.71 ft	T1 Flow	27.2 ft ³ /s
T2 Elevation	381.97 ft	T2 Flow	31.0 ft ³ /s


MCADAMS

Subsection: Outlet Input Data

Label: SCMA

Scenario: Post-Dev 1 yr

 Return Event: 1 years
 Storm Event: 1 yr

Structure ID: Riser	
Structure Type: Inlet Box	
Number of Openings	1
Elevation	383.75 ft
Orifice Area	16.0 ft ²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False
Structure ID: WQOrifice	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	380.00 ft
Orifice Diameter	2.25 in
Orifice Coefficient	1
Structure ID: Orifice 1yr	
Structure Type: Orifice-Area	
Number of Openings	1
Elevation	382.00 ft
Orifice Area	1.5 ft ²
Top Elevation	382.50 ft
Datum Elevation	382.25 ft
Orifice Coefficient	1
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.0 ft ³ /s
Flow Tolerance (Maximum)	10.0 ft ³ /s

Subsection: Composite Rating Curve

Label: SCMA

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
380.00	0.0	(N/A)	0.00	(no Q: Orifice 1yr,Riser,WQOrifice,Culvert)
380.10	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.20	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.40	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.50	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.60	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.70	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.80	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
380.90	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.00	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.10	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.20	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.40	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.50	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.60	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.70	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.80	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
381.90	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
382.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice 1yr,Riser)
382.10	0.9	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.20	1.6	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.30	2.4	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)

Subsection: Composite Rating Curve

Label: SCMA

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
382.40	3.1	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.50	3.8	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.60	4.5	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.70	5.1	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.80	5.6	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
382.90	6.0	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.00	6.5	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.10	6.9	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.20	7.3	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.30	7.6	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.40	8.0	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.50	8.3	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.60	8.6	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.70	8.9	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.75	9.1	(N/A)	0.00	Orifice 1yr,WQOrifice,Culvert (no Q: Riser)
383.80	9.8	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culver t
383.90	12.3	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culver t
384.00	15.8	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culver t



Subsection: Composite Rating Curve

Label: SCMA

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
384.10	20.0	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.20	24.8	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.30	30.1	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.40	35.6	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.50	40.6	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.60	45.5	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.70	50.4	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.80	54.7	(N/A)	0.00	Orifice 1yr,Riser,WQOrifice,Culvert
384.90	56.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.00	57.2	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.10	57.8	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.20	58.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.30	59.1	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.40	59.8	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.50	60.4	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.60	61.0	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.70	61.7	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.80	62.3	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
385.90	62.9	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)
386.00	63.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice 1yr,WQOrifice)



Subsection: Level Pool Pond Routing Summary

Label: SCM A (IN)

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	380.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	32.8 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	3.9 ft³/s	Time to Peak (Flow, Outlet)	754.00 min

Elevation (Water Surface, Peak)	382.51 ft
Volume (Peak)	0.812 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	1.523 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.885 ac-ft
Volume (Retained)	0.637 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM A (IN)

Scenario: Post-Dev 2 yr

Return Event: 2 years

Storm Event: 2 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	380.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	42.6 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	6.5 ft ³ /s	Time to Peak (Flow, Outlet)	753.00 min

Elevation (Water Surface, Peak)	383.01 ft
Volume (Peak)	1.002 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.051 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	1.406 ac-ft
Volume (Retained)	0.644 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM A (IN)

Scenario: Post-Dev 10 yr

Return Event: 10 years

Storm Event: 10 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	380.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	64.3 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	21.6 ft³/s	Time to Peak (Flow, Outlet)	730.00 min

Elevation (Water Surface, Peak)	384.13 ft
Volume (Peak)	1.464 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.543 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.884 ac-ft
Volume (Retained)	0.658 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM A (IN)

Scenario: Post-Dev 25 yr

Return Event: 25 years

Storm Event: 25 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	380.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	75.3 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	40.1 ft³/s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	384.49 ft
Volume (Peak)	1.620 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.473 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	3.809 ac-ft
Volume (Retained)	0.663 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM A (IN)

Scenario: Post-Dev 100 yr

Return Event: 100 years

Storm Event: 100 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	380.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	91.2 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	56.8 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	384.95 ft
Volume (Peak)	1.825 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	6.034 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	5.368 ac-ft
Volume (Retained)	0.665 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



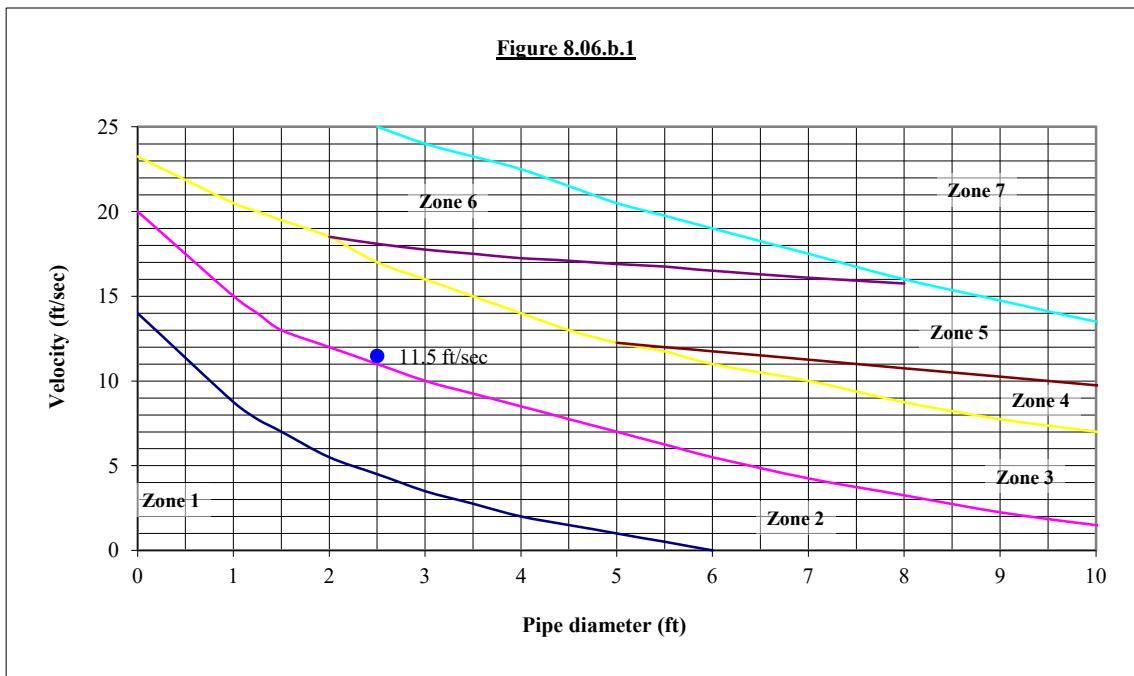
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- SCM A (IN) (Level Pool Pond Routing Summary, 10 years (Post-Dev 10 yr))...10
- SCM A (IN) (Level Pool Pond Routing Summary, 100 years (Post-Dev 100 yr))...12
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- SCM A (IN) (Level Pool Pond Routing Summary, 25 years (Post-Dev 25 yr))...11
- SCMA (Composite Rating Curve, 1 years (Post-Dev 1 yr))...5, 6, 7
- SCMA (Outlet Input Data, 1 years (Post-Dev 1 yr))...2, 3, 4

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	<u>The Point</u>	Date	<u>11/23/2020</u>
Project No.	<u>AWH-20000</u>	Designer	<u>TKD</u>
Outlet ID	<u>SCM A</u>		
Flow, $Q_{10\text{-yr}}$	<u>21.6</u> cfs		
Slope, S	<u>2.16</u> %		
Pipe Diameter, D_o	<u>30</u> inches		
Pipe Diameter, D_o	<u>2.5</u> feet		
Number of pipes	<u>1</u>		
Pipe separation	<u>0</u> feet		
Manning's n	<u>0.013</u>		



Zone from graph above = 3

Outlet pipe diameter	<u>30 in.</u>	Length =	<u>20.0 ft.</u>
Outlet flowrate	<u>21.6 cfs</u>	Width =	<u>7.5 ft.</u>
Outlet velocity	<u>11.5 ft/sec</u>	Stone diameter =	<u>13 in.</u>
Material =	<u>Class I</u>	Thickness =	<u>22 in.</u>

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	$4 \times D(o)$	$3 \times D(o)$
2	Class B	6	22	$6 \times D(o)$	$3 \times D(o)$
3	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
4	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
5	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
6	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = **1.15** (recommend 1.15 or higher)

Concrete:

Concrete unit weight = **142.0** PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = **4.75** feet
Inside length of riser = **4.00** feet
Inside width of riser = **4.00** feet
Wall thickness of riser = **6.00** inches
Base thickness of riser = **6.00** inches
Base length of riser = **5.00** feet
Base width of riser = **5.00** feet

Openings:

Total Orifice Area = **1.587** SF
OD of barrel exiting manhole = **37.00** inches
Size of drain pipe (if present) = **6.0** inches

Trash Rack:

Bottom Length = **7.00** feet
Bottom Width = **7.00** feet
Top Length = **1.00** feet
Top Width = **1.00** feet
Height = **2.00** feet
Trash Rack water displacement = **38.00** CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = **12.50** CF
Riser Walls = **42.75** CF

Adjust for openings:

Opening for Orifices = **0.79** CF
Opening for barrel = **3.73** CF
Opening for drain pipe = **0.10** CF

Total Concrete present, adjusted for openings = **50.625 CF**
Weight of concrete present = **7,189 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	50.62 CF
Displacement by open air in riser =	76.00 CF
Displacement by trash rack =	38.00 CF
Total water displaced by riser/barrel structure =	164.62 CF
Weight of water displaced =	10,273 lbs

Calculate size of base for riser assembly ==>

Length =	8.00 feet
Width =	8.00 feet
Thickness =	12 inches
Concrete Present =	64.00 CF

Check validity of base as designed ==>

Total Water Displaced =	216.12 CF
Total Concrete Present =	114.62 CF
Total Water Displaced =	13,486 lbs
Total Concrete Present =	16,277 lbs
Actual safety factor =	1.21 OK

Results of design ==>

Base length =	8.00 feet
Base width =	8.00 feet
Base Thickness =	12.00 inches
CY of concrete total in base =	2.37 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 8.0 feet
Anti-Floatation Block Width = 8.0 feet
Anti-Floatation Block Thickness = 12 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or h)

Cross-Section Calculations==>

Cross-Section Area* = 8.00 SF
Minimum Steel Area Required = 0.016 SF
2.30 SI

*Note: Assumes a "square" x-sec (L and W same)

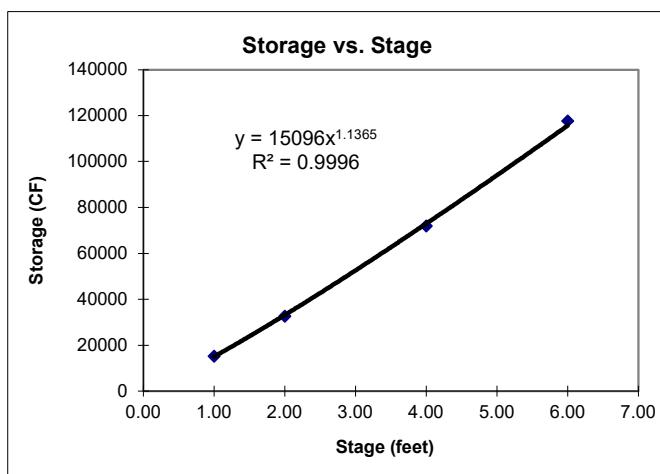
Rebar Calculations ==>

Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	12	8	6	4	3

STORMWATER CONTROL MEASURE 'C'
DESIGN CALCULATIONS

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
376.00	0.00	13,922				
377.00	1.00	16,657	15290	15290	15290	1.01
378.00	2.00	18,109	17383	17383	32673	1.97
380.00	4.00	21,183	19646	39292	71965	3.95
382.00	6.00	24,484	22834	45667	117632	6.09

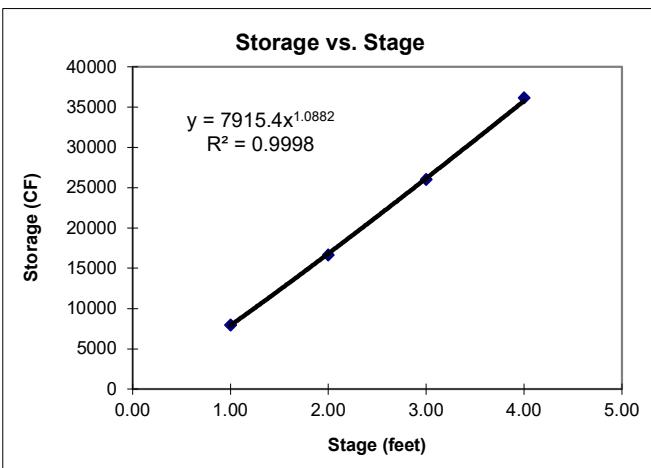


$K_s =$	15096
$b =$	1.1365

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
371.00	-1.00	6,974				
372.00	0.00	7,630				Sediment Storage
373.00	1.00	8,311	7971	7971	7971	1.01
374.00	2.00	9,018	8665	8665	16635	1.98
375.00	3.00	9,749	9384	9384	26019	2.98
376.00	4.00	10,506	10128	10128	36146	4.04

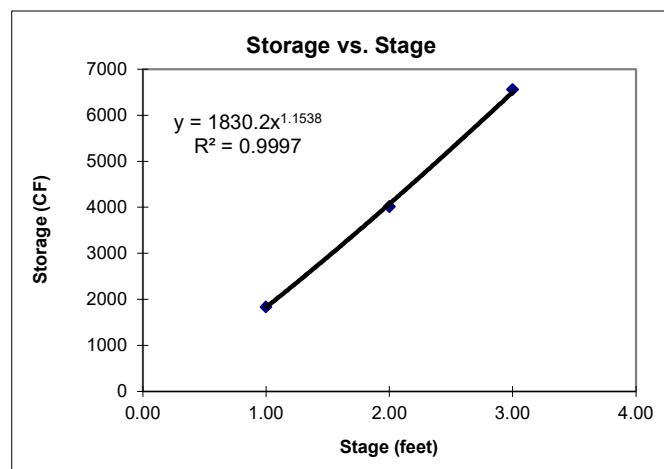
*surface area and volume used for avg. depth calculation



$K_s =$	7915
$b =$	1.0882

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
372.00	-1.00	1,376				
373.00	0.00	1,677				Sediment Storage
374.00	1.00	2,002	1840	1840	1840	1.00
375.00	2.00	2,353	2178	2178	4017	1.98
376.00	3.00	2,729	2541	2541	6558	3.02



$K_s =$	1830.2
$b =$	1.1538

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool= 36,146 cf
Volume of Forebay below Normal Pool= 6,558 cf
Total Volume Below Normal Pool = 42,704 cf
Total Volume Above Normal Pool= 117,632 cf
Total Volume of Facility = 160,336 cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume = 36,146 cf
Provided Forebay Volume = 6,558 cf
Provided Forebay Volume % = 18%

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool = 36,146 cf
Main Pool Area at Normal Pool = 10,506 sf
Average Depth = **3.44** ft

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond = 15.68 acres
Total impervious area to pond = 9.14 acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **15.68** acres @ **58.3%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = **3.44** feet (*Hard Coded*)

	3.0	3.44	4.0
Lower Boundary =>	50.0	1.79	1.51
Site % impervious =>	58.3	2.04	1.72
Upper Boundary =>	60.0	2.09	1.77

Therefore, SA/DA required = **1.90**

Surface area required for main pool at normal pool = 12,977 ft²
= 0.30 acres

Surface area provided for total normal pool = 13,922 ft²

Surface area estimate for main pool at normal pool = 10,506 ft²

DETERMINATION OF WATER QUALITY VOLUME

$$WQ_V = (P)(R_V)(A)/12$$

where,

WQ_V = water quality volume (in acre-ft)

$R_V = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	15.68	acres
Impervious area =	9.14	acres
Percent impervious cover, I =	58.3	%
Rainfall, P =	1.00	inches

Calculated values:

$R_V =$	0.57	
$WQ_V =$	0.75	acre-ft
=	32692	cf.

ASSOCIATED DEPTH IN POND

$$WQ_V = 32692 \text{ cf.}$$

Stage / Storage Data:

$K_s =$	15096	
$b =$	1.137	
$Z_o =$	376.00	
Volume in 1" rainfall =	32692	cf.

Calculated values:

Depth of WQv in Basin =	1.97	ft
=	23.68	inches
Elevation =	377.97	ft

DRAWDOWN ORIFICE DESIGN

D orifice =	2.5 inch
# orifices =	1
Ks =	15096
b =	1.1365
C _d orifice =	0.60
Normal Pool Elevation =	376.00 feet
Volume @ Normal Pool =	0 cf
Orifice Invert =	376.00 feet
WSEL @ 1" Runoff Volume =	377.97 feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
377.97	32692	0.224			
377.80	29486	0.214	0.219	3206	14652
377.63	26321	0.202	0.208	3165	15213
377.46	23202	0.191	0.197	3119	15864
377.29	20132	0.178	0.185	3070	16633
377.12	17118	0.165	0.172	3014	17564
376.95	14166	0.150	0.158	2952	18726
376.77	11287	0.134	0.142	2879	20242
376.60	8494	0.116	0.125	2793	22353
376.43	5809	0.094	0.105	2685	25634
376.26	3269	0.065	0.079	2540	32047

Drawdown Time =	2.30 days
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By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.623 feet
Orifice composite loss coefficient =	0.600
Cross-sectional area of siphon =	0.034 sf

Q = 0.1296 cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.92 days
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Subsection: Elevation-Area Volume Curve

Label: SCM C

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ac-ft)	Volume (Total) (ac-ft)
376.00	0.0	13,922	0	0.000	0.000
377.00	0.0	16,657	45,807	0.351	0.351
378.00	0.0	18,109	52,134	0.399	0.749
379.00	0.0	19,618	56,575	0.433	1.182
380.00	0.0	21,183	61,186	0.468	1.651
381.00	0.0	22,805	65,967	0.505	2.155
382.00	0.0	24,484	70,919	0.543	2.698



Subsection: Outlet Input Data

Label: SCMC

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	376.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	382.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 1yr	Forward	Culvert	378.25	382.00
Inlet Box	Riser	Forward	Culvert	380.00	382.00
Orifice-Circular	WQOrifice	Forward	Culvert	376.00	382.00
Culvert-Circular	Culvert	Forward	TW	374.50	382.00
Tailwater Settings	Tailwater			(N/A)	(N/A)



Subsection: Outlet Input Data

Label: SCMC

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Culvert
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	42.00 in
Length	48.94 ft
Length (Computed Barrel)	49.00 ft
Slope (Computed)	0.051 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0
Kb	0
Kr	0
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	378.24 ft	T1 Flow	63.0 ft ³ /s
T2 Elevation	378.60 ft	T2 Flow	72.0 ft ³ /s



Subsection: Outlet Input Data

Label: SMC

Scenario: Post-Dev 1 yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Riser	
Structure Type: Inlet Box	
Number of Openings	1
Elevation	380.00 ft
Orifice Area	25.0 ft ²
Orifice Coefficient	1
Weir Length	20.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False
Structure ID: WQOrifice	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	376.00 ft
Orifice Diameter	2.50 in
Orifice Coefficient	1
Structure ID: Orifice - 1yr	
Structure Type: Orifice-Area	
Number of Openings	3
Elevation	378.25 ft
Orifice Area	2.3 ft ²
Top Elevation	379.00 ft
Datum Elevation	378.63 ft
Orifice Coefficient	1
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.0 ft ³ /s
Flow Tolerance (Maximum)	10.0 ft ³ /s

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
376.00	0.0	(N/A)	0.00	(no Q: Orifice - 1yr,Riser,WQOrifice,Culvert)
376.10	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.20	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.40	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.50	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.60	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.70	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.80	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
376.90	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.10	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.20	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.30	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.40	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.50	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.60	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.70	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.80	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
377.90	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
378.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
378.10	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
378.20	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
378.25	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
378.30	1.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)

Subsection: Composite Rating Curve

Label: SMC

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
378.40	4.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
378.50	6.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
378.60	9.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
378.70	12.1	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
378.80	14.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
378.90	17.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.00	20.0	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.10	22.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.20	24.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.30	26.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.40	28.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.50	30.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.60	32.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.70	33.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.80	35.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
379.90	36.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
380.00	38.3	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
380.10	41.5	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert

Subsection: Composite Rating Curve

Label: SMC

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
380.20	46.3	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.30	52.1	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.40	58.6	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.50	65.9	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.60	72.3	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.70	78.0	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.80	83.8	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
380.90	89.2	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.00	94.4	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.10	99.7	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.20	104.6	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.30	109.2	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.40	113.3	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.50	116.4	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
381.60	118.1	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
381.70	119.3	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
381.80	120.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
381.90	121.7	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
382.00	122.9	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)



Subsection: Level Pool Pond Routing Summary

Label: SCM C (IN)

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	376.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	43.5 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	8.3 ft³/s	Time to Peak (Flow, Outlet)	752.00 min

Elevation (Water Surface, Peak)	378.55 ft
Volume (Peak)	0.985 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.014 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	1.156 ac-ft
Volume (Retained)	0.858 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM C (IN)

Scenario: Post-Dev 2 yr

Return Event: 2 years

Storm Event: 2 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	376.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	56.0 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	16.8 ft³/s	Time to Peak (Flow, Outlet)	730.00 min

Elevation (Water Surface, Peak)	378.88 ft
Volume (Peak)	1.127 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.692 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	1.831 ac-ft
Volume (Retained)	0.861 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM C (IN)

Scenario: Post-Dev 10 yr

Return Event: 10 years

Storm Event: 10 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	376.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	83.2 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	37.5 ft³/s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	379.95 ft
Volume (Peak)	1.625 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.598 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	3.731 ac-ft
Volume (Retained)	0.866 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM C (IN)

Scenario: Post-Dev 25 yr

Return Event: 25 years

Storm Event: 25 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	376.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	97.0 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	53.5 ft³/s	Time to Peak (Flow, Outlet)	727.00 min

Elevation (Water Surface, Peak)	380.32 ft
Volume (Peak)	1.809 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	5.781 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	4.911 ac-ft
Volume (Retained)	0.868 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM C (IN)

Scenario: Post-Dev 100 yr

Return Event: 100 years

Storm Event: 100 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	376.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	116.8 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	75.3 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	380.65 ft
Volume (Peak)	1.976 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	7.762 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	6.891 ac-ft
Volume (Retained)	0.868 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



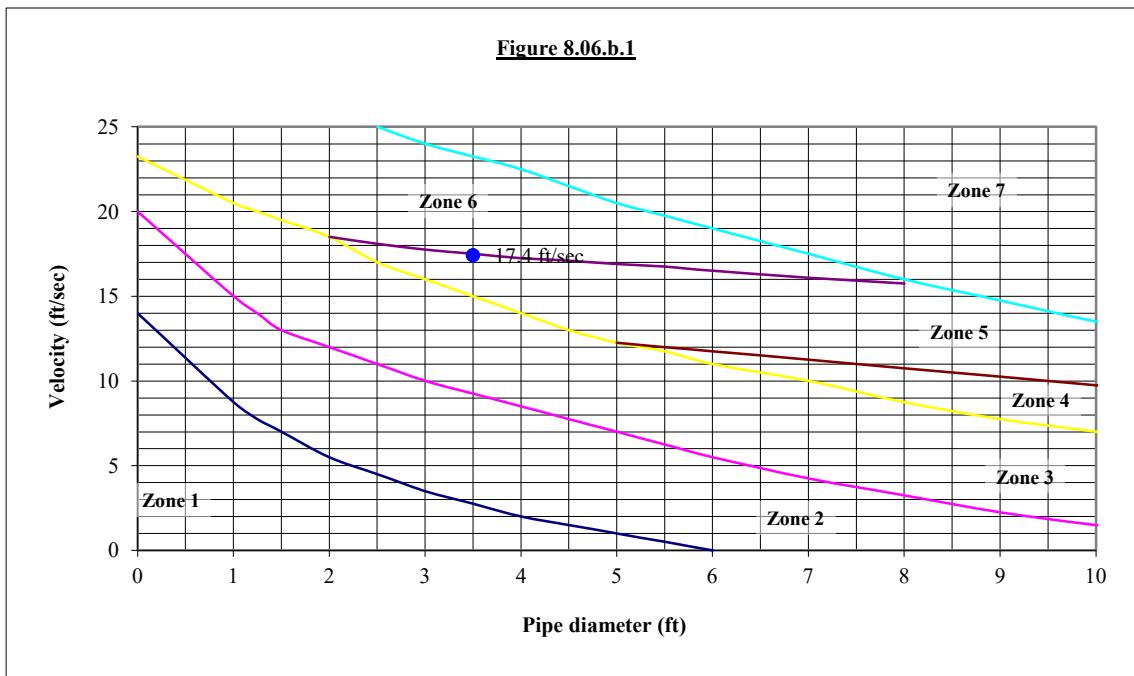
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DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	<u>The Point</u>	Date	<u>11/23/2020</u>
Project No.	<u>AWH-20000</u>	Designer	<u>TKD</u>
Outlet ID	<u>SCM C</u>		
Flow, $Q_{10\text{-yr}}$	<u>37.5</u> cfs		
Slope, S	<u>5.11</u> %		
Pipe Diameter, D_o	<u>42</u> inches		
Pipe Diameter, D_o	<u>3.5</u> feet		
Number of pipes	<u>1</u>		
Pipe separation	<u>0</u> feet		
Manning's n	<u>0.013</u>		



Zone from graph above = 5

Outlet pipe diameter	<u>42 in.</u>	Length =	<u>35.0 ft.</u>
Outlet flowrate	<u>37.5 cfs</u>	Width =	<u>10.5 ft.</u>
Outlet velocity	<u>17.4 ft/sec</u>	Stone diameter =	<u>23 in.</u>
Material =	<u>Class II</u>	Thickness =	<u>27 in.</u>

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	$4 \times D(o)$	$3 \times D(o)$
2	Class B	6	22	$6 \times D(o)$	$3 \times D(o)$
3	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
4	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
5	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
6	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = **1.15** (recommend 1.15 or higher)

Concrete:

Concrete unit weight = **142.0** PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = **5.50** feet
Inside length of riser = **5.00** feet
Inside width of riser = **5.00** feet
Wall thickness of riser = **6.00** inches
Base thickness of riser = **6.00** inches
Base length of riser = **6.00** feet
Base width of riser = **6.00** feet

Openings:

Total Orifice Area = **6.886** SF
OD of barrel exiting manhole = **51.00** inches
Size of drain pipe (if present) = **6.0** inches

Trash Rack:

Bottom Length = **8.40** feet
Bottom Width = **8.40** feet
Top Length = **2.10** feet
Top Width = **2.10** feet
Height = **2.00** feet
Trash Rack water displacement = **61.74** CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = **18.00** CF
Riser Walls = **60.50** CF

Adjust for openings:

Opening for Orifices = **3.44** CF
Opening for barrel = **7.09** CF
Opening for drain pipe = **0.10** CF

Total Concrete present, adjusted for openings = **67.866 CF**
Weight of concrete present = **9,637 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	67.87 CF
Displacement by open air in riser =	137.50 CF
Displacement by trash rack =	61.74 CF
Total water displaced by riser/barrel structure =	267.11 CF
Weight of water displaced =	16,667 lbs

Calculate size of base for riser assembly ==>

Length =	9.00 feet
Width =	9.00 feet
Thickness =	18 inches
Concrete Present =	121.50 CF

Check validity of base as designed ==>

Total Water Displaced =	370.61 CF
Total Concrete Present =	189.37 CF
Total Water Displaced =	23,126 lbs
Total Concrete Present =	26,890 lbs
Actual safety factor =	1.16 OK

Results of design ==>

Base length =	9.00 feet
Base width =	9.00 feet
Base Thickness =	18.00 inches
CY of concrete total in base =	4.50 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 9.0 feet
Anti-Floatation Block Width = 9.0 feet
Anti-Floatation Block Thickness = 18 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or h)

Cross-Section Calculations==>

Cross-Section Area* = 13.50 SF
Minimum Steel Area Required = 0.027 SF
3.89 SI

*Note: Assumes a "square" x-sec (L and W same)

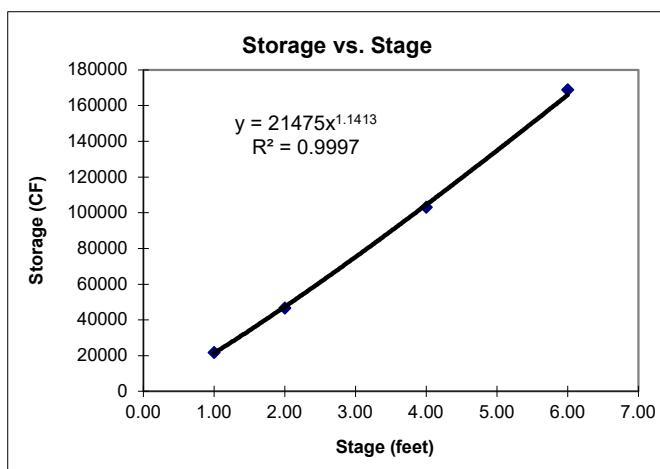
Rebar Calculations ==>

Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	20	13	9	7	5

STORMWATER CONTROL MEASURE 'D'
DESIGN CALCULATIONS

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
354.00	0.00	19,672				
355.00	1.00	23,820	21746	21746	21746	1.01
356.00	2.00	25,979	24900	24900	46646	1.97
358.00	4.00	30,467	28223	56446	103092	3.95
360.00	6.00	35,181	32824	65648	168740	6.09

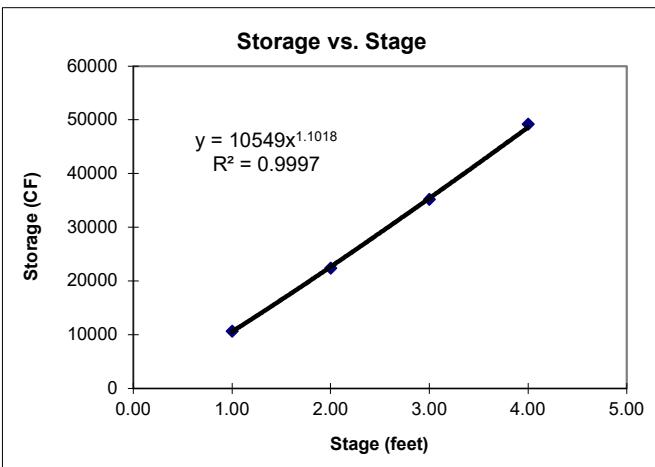


$K_s =$	21475
$b =$	1.1413

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
349.00	-1.00	9,046				
350.00	0.00	10,094				Sediment Storage
351.00	1.00	11,168	10631	10631	10631	1.01
352.00	2.00	12,266	11717	11717	22348	1.98
353.00	3.00	13,390	12828	12828	35176	2.98
354.00	4.00	14,539	13965	13965	49141	4.04

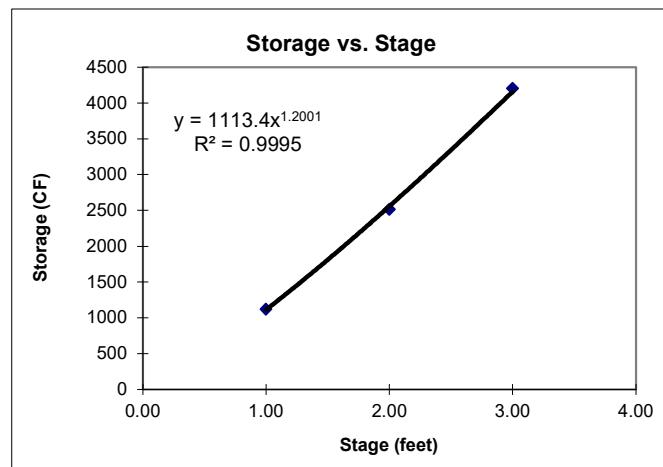
*surface area and volume used for avg. depth calculation



$K_s = 10549$ $b = 1.1018$

STAGE-STORAGE FUNCTION - FOREBAY

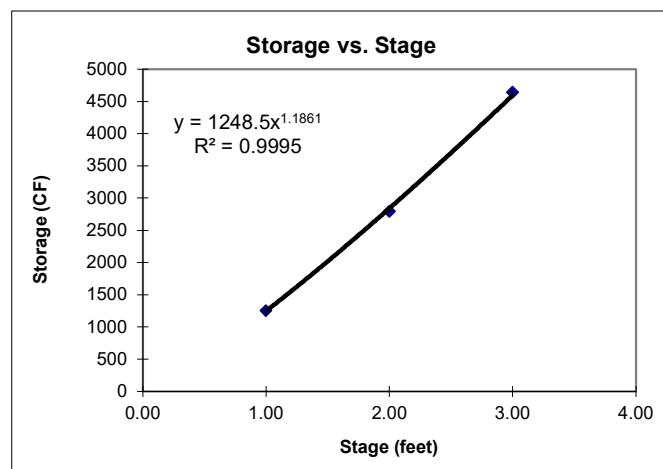
Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
350.00	-1.00	754				
351.00	0.00	990				Sediment Storage
352.00	1.00	1,251	1121	1121	1121	1.01
353.00	2.00	1,537	1394	1394	2515	1.97
354.00	3.00	1,848	1693	1693	4207	3.03



$K_s =$	1113.4
$b =$	1.2001

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
350.00	-1.00	875				
351.00	0.00	1,121				Sediment Storage
352.00	1.00	1,391	1256	1256	1256	1.01
353.00	2.00	1,687	1539	1539	2795	1.97
354.00	3.00	2,008	1848	1848	4643	3.03



$K_s =$	1248.5
$b =$	1.1861

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool=	49,141	cf
Volume of Forebay below Normal Pool=	8,850	cf
Total Volume Below Normal Pool =	57,990	cf
Total Volume Above Normal Pool=	168,740	cf
Total Volume of Facility =	226,730	cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume =	49,141	cf
Provided Forebay Volume =	8,850	cf
Provided Forebay Volume % =	18%	

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool =	49,141	cf
Main Pool Area at Normal Pool =	14,539	sf
Average Depth =	3.38	ft

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond = 13.21 acres
Total impervious area to pond = 6.68 acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **13.21** acres @ **50.6%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = **3.38** feet

	3.0	3.38	4.0
Lower Boundary =>	50.0	1.79	1.51
Site % impervious =>	50.6	1.81	1.53
Upper Boundary =>	60.0	2.09	1.77

Therefore, SA/DA required = **1.70**

Surface area required for main pool at normal pool = 9,785 ft²
= 0.22 acres

Surface area provided for total normal pool = 19,672 ft²

Surface area estimate for main pool at normal pool = 14,539 ft²

DETERMINATION OF WATER QUALITY VOLUME

$$WQ_V = (P)(R_V)(A)/12$$

where,

WQ_V = water quality volume (in acre-ft)

$R_V = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	13.21	acres
Impervious area =	6.68	acres
Percent impervious cover, I =	50.6	%
Rainfall, P =	1.00	inches

Calculated values:

$R_V =$	0.51	
$WQ_V =$	0.56	acre-ft
=	24232	cf.

ASSOCIATED DEPTH IN POND

$$WQ_V = 24232 \text{ cf.}$$

Stage / Storage Data:

$K_s =$	21475	
$b =$	1.141	
$Z_o =$	354.00	
Volume in 1" rainfall =	24232	cf.

Calculated values:

Depth of WQv in Basin =	1.11	ft
=	13.34	inches
Elevation =	355.11	ft

DRAWDOWN ORIFICE DESIGN

D orifice =	2.75 inch
# orifices =	1
Ks =	21475
b =	1.1413
C _d orifice =	0.60
Normal Pool Elevation =	354.00 feet
Volume @ Normal Pool =	0 cf
Orifice Invert =	354.00 feet
WSEL @ 1" Runoff Volume =	355.11 feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
355.11	24232	0.198			
355.02	21849	0.188	0.193	2383	12340
354.92	19498	0.178	0.183	2351	12847
354.82	17182	0.167	0.172	2316	13441
354.73	14904	0.155	0.161	2278	14155
354.63	12668	0.142	0.149	2236	15036
354.53	10480	0.128	0.135	2188	16167
354.44	8348	0.113	0.120	2132	17702
354.34	6281	0.094	0.103	2066	19979
354.24	4297	0.071	0.083	1984	23956
354.15	2423	0.035	0.053	1874	35263

Drawdown Time =	2.09 days
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By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.332 feet
Orifice composite loss coefficient =	0.600
Cross-sectional area of siphon =	0.041 sf

Q = 0.1145 cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.45 days
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Subsection: Elevation-Area Volume Curve

Label: SCM D

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ac-ft)	Volume (Total) (ac-ft)
354.00	0.0	19,672	0	0.000	0.000
355.00	0.0	23,820	65,139	0.498	0.498
356.00	0.0	25,979	74,675	0.571	1.070
357.00	0.0	28,195	81,238	0.622	1.692
358.00	0.0	30,467	87,971	0.673	2.365
359.00	0.0	32,796	94,873	0.726	3.091
360.00	0.0	35,181	101,945	0.780	3.871



Subsection: Outlet Input Data

Label: SCMD

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	354.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	360.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1yr	Forward	Culvert	355.50	360.00
Inlet Box	Riser	Forward	Culvert	358.00	360.00
Orifice-Circular	WQOrifice	Forward	Culvert	354.00	360.00
Culvert-Circular	Culvert	Forward	TW	353.00	360.00
Tailwater Settings	Tailwater			(N/A)	(N/A)



Subsection: Outlet Input Data

Label: SCMD

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Culvert
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	24.00 in
Length	48.27 ft
Length (Computed Barrel)	48.28 ft
Slope (Computed)	0.021 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0
Kb	0
Kr	0
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	355.17 ft	T1 Flow	15.6 ft ³ /s
T2 Elevation	355.37 ft	T2 Flow	17.8 ft ³ /s



Subsection: Outlet Input Data

Label: SCMD

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Riser	
Structure Type: Inlet Box	
Number of Openings	1
Elevation	358.00 ft
Orifice Area	16.0 ft ²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False
Structure ID: WQOrifice	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	354.00 ft
Orifice Diameter	2.50 in
Orifice Coefficient	1
Structure ID: Orifice - 1yr	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	355.50 ft
Orifice Diameter	8.00 in
Orifice Coefficient	1
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.0 ft ³ /s
Flow Tolerance (Maximum)	10.0 ft ³ /s

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
354.00	0.0	(N/A)	0.00	(no Q: Orifice - 1yr,Riser,WQOrifice,Culvert)
354.10	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.20	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.40	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.50	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.60	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.70	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.80	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
354.90	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.10	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.20	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.30	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.40	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.50	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.60	0.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
355.70	0.3	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
355.80	0.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
355.90	0.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.00	0.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.10	1.0	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
356.20	1.3	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.30	1.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.40	1.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.50	1.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.60	1.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.70	1.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.80	1.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
356.90	2.0	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.00	2.1	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.10	2.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.20	2.3	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.30	2.3	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.40	2.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.50	2.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.60	2.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.70	2.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.80	2.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.90	2.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
358.00	2.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.10	4.4	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.20	7.2	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.30	10.8	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.40	15.1	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.50	20.0	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.60	25.0	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.70	30.3	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.80	35.5	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
358.90	37.6	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.00	38.0	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.10	38.4	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.20	38.8	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.30	39.2	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.40	39.6	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.50	40.0	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.60	40.4	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.70	40.8	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.80	41.2	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
359.90	41.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
360.00	41.9	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)



Subsection: Level Pool Pond Routing Summary

Label: SCM D (IN)

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	354.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	28.0 ft³/s	Time to Peak (Flow, In)	722.00 min
Flow (Peak Outlet)	0.5 ft³/s	Time to Peak (Flow, Outlet)	1,083.00 min

Elevation (Water Surface, Peak)	355.83 ft
Volume (Peak)	0.967 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	1.327 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.391 ac-ft
Volume (Retained)	0.935 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM D (IN)

Scenario: Post-Dev 2 yr

Return Event: 2 years

Storm Event: 2 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	354.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	37.9 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	1.2 ft ³ /s	Time to Peak (Flow, Outlet)	903.00 min

Elevation (Water Surface, Peak)	356.16 ft
Volume (Peak)	1.167 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	1.843 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	0.835 ac-ft
Volume (Retained)	1.007 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM D (IN)

Scenario: Post-Dev 10 yr

Return Event: 10 years

Storm Event: 10 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	354.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	61.0 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	2.5 ft³/s	Time to Peak (Flow, Outlet)	787.00 min

Elevation (Water Surface, Peak)	357.53 ft
Volume (Peak)	2.041 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.341 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.062 ac-ft
Volume (Retained)	1.276 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.1 %



Subsection: Level Pool Pond Routing Summary

Label: SCM D (IN)

Scenario: Post-Dev 25 yr

Return Event: 25 years

Storm Event: 25 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	354.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	73.0 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	6.7 ft³/s	Time to Peak (Flow, Outlet)	780.00 min

Elevation (Water Surface, Peak)	358.18 ft
Volume (Peak)	2.493 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.291 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.778 ac-ft
Volume (Retained)	1.510 ac-ft
Volume (Unrouted)	-0.003 ac-ft
Error (Mass Balance)	0.1 %



Subsection: Level Pool Pond Routing Summary

Label: SCM D (IN)

Scenario: Post-Dev 100 yr

Return Event: 100 years

Storm Event: 100 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	354.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	90.5 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	25.4 ft ³ /s	Time to Peak (Flow, Outlet)	751.00 min

Elevation (Water Surface, Peak)	358.61 ft
Volume (Peak)	2.798 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	5.902 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	4.272 ac-ft
Volume (Retained)	1.627 ac-ft
Volume (Unrouted)	-0.003 ac-ft
Error (Mass Balance)	0.0 %



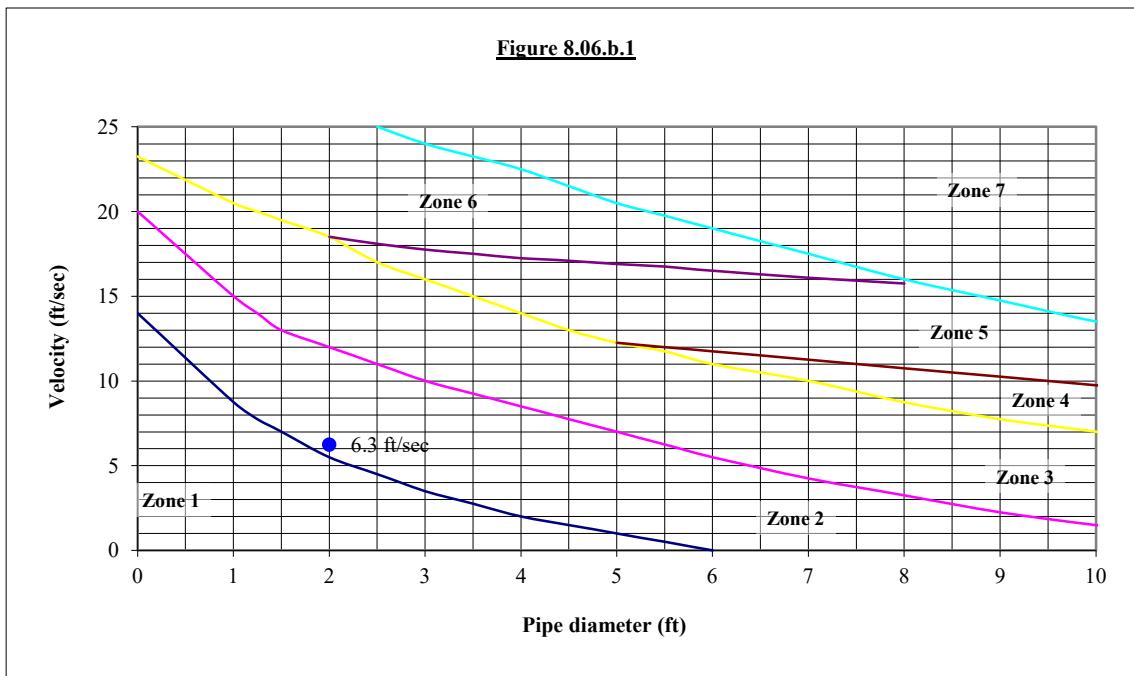
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DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	<u>The Point</u>	Date	<u>11/23/2020</u>
Project No.	<u>AWH-2000</u>	Designer	<u>TKD</u>
Outlet ID	<u>SCM D</u>		
Flow, $Q_{10\text{-yr}}$	<u>2.5</u> cfs		
Slope, S	<u>2.07</u> %		
Pipe Diameter, D_o	<u>24</u> inches		
Pipe Diameter, D_o	<u>2.0</u> feet		
Number of pipes	<u>1</u>		
Pipe separation	<u>0</u> feet		
Manning's n	<u>0.013</u>		



Zone from graph above = 2

Outlet pipe diameter	<u>24 in.</u>	Length =	<u>12.0 ft.</u>
Outlet flowrate	<u>2.5 cfs</u>	Width =	<u>6.0 ft.</u>
Outlet velocity	<u>6.3 ft/sec</u>	Stone diameter =	<u>6 in.</u>
Material =	<u>Class B</u>	Thickness =	<u>22 in.</u>

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	$4 \times D(o)$	$3 \times D(o)$
2	Class B	6	22	$6 \times D(o)$	$3 \times D(o)$
3	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
4	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
5	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
6	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = **1.15** (recommend 1.15 or higher)

Concrete:

Concrete unit weight = **142.0** PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = **5.00** feet
Inside length of riser = **4.00** feet
Inside width of riser = **4.00** feet
Wall thickness of riser = **6.00** inches
Base thickness of riser = **6.00** inches
Base length of riser = **5.00** feet
Base width of riser = **5.00** feet

Openings:

Total Orifice Area = **1.561** SF
OD of barrel exiting manhole = **30.00** inches
Size of drain pipe (if present) = **6.0** inches

Trash Rack:

Bottom Length = **7.00** feet
Bottom Width = **7.00** feet
Top Length = **1.00** feet
Top Width = **1.00** feet
Height = **2.00** feet
Trash Rack water displacement = **38.00** CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = **12.50** CF
Riser Walls = **45.00** CF

Adjust for openings:

Opening for Orifices = **0.78** CF
Opening for barrel = **2.45** CF
Opening for drain pipe = **0.10** CF

Total Concrete present, adjusted for openings = **54.167 CF**
Weight of concrete present = **7,692 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	54.17 CF
Displacement by open air in riser =	80.00 CF
Displacement by trash rack =	38.00 CF
Total water displaced by riser/barrel structure =	172.17 CF
Weight of water displaced =	10,743 lbs

Calculate size of base for riser assembly ==>

Length =	8.00 feet
Width =	8.00 feet
Thickness =	12 inches
Concrete Present =	64.00 CF

Check validity of base as designed ==>

Total Water Displaced =	223.67 CF
Total Concrete Present =	118.17 CF
Total Water Displaced =	13,957 lbs
Total Concrete Present =	16,780 lbs
Actual safety factor =	1.20 OK

Results of design ==>

Base length =	8.00 feet
Base width =	8.00 feet
Base Thickness =	12.00 inches
CY of concrete total in base =	2.37 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 8.0 feet
Anti-Floatation Block Width = 8.0 feet
Anti-Floatation Block Thickness = 12 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or h)

Cross-Section Calculations==>

Cross-Section Area* = 8.00 SF
Minimum Steel Area Required = 0.016 SF
2.30 SI

*Note: Assumes a "square" x-sec (L and W same)

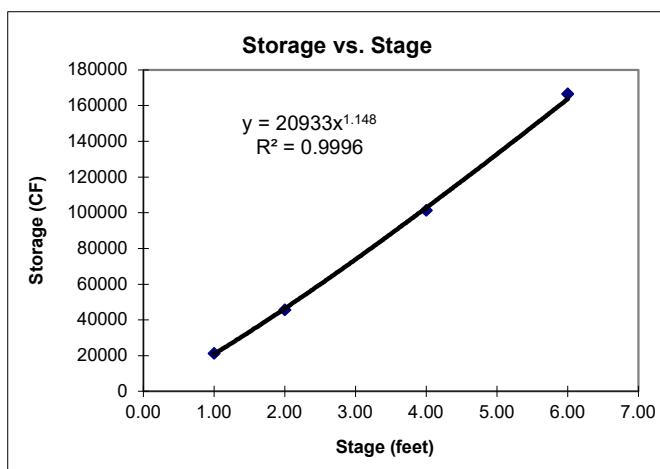
Rebar Calculations ==>

Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	12	8	6	4	3

STORMWATER CONTROL MEASURE 'E'
DESIGN CALCULATIONS

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
355.00	0.00	19,072				
356.00	1.00	23,339	21206	21206	21206	1.01
357.00	2.00	25,557	24448	24448	45654	1.97
359.00	4.00	30,162	27860	55719	101373	3.95
361.00	6.00	34,994	32578	65156	166529	6.09

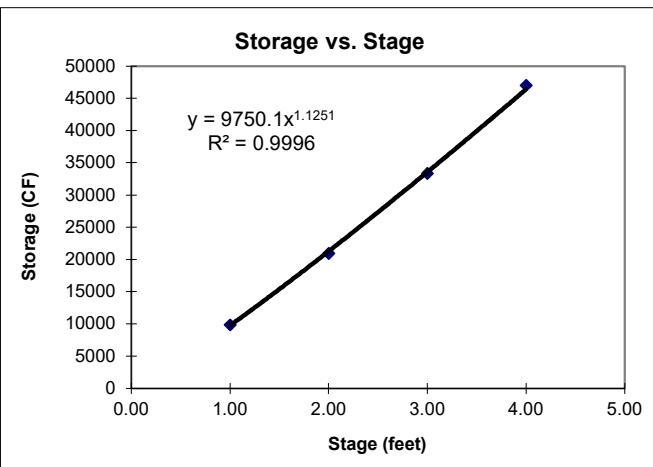


$K_S =$	20933
$b =$	1.1480

STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
350.00	-1.00	7,998				
351.00	0.00	9,218				Sediment Storage
352.00	1.00	10,463	9841	9841	9841	1.01
353.00	2.00	11,735	11099	11099	20940	1.97
354.00	3.00	13,030	12383	12383	33322	2.98
355.00	4.00	14,351	13691	13691	47013	4.05

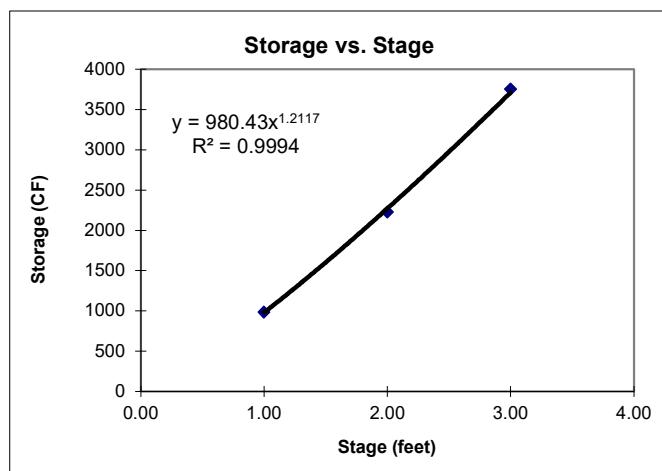
*surface area and volume used for avg. depth calculation



$K_s = 9750$ $b = 1.1251$

STAGE-STORAGE FUNCTION - FOREBAY

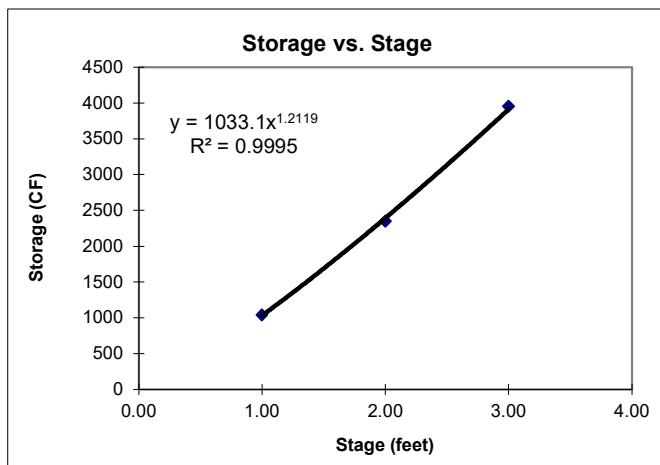
Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
351.00	-1.00	647				
352.00	0.00	865				Sediment Storage
353.00	1.00	1,109	987	987	987	1.01
354.00	2.00	1,377	1243	1243	2230	1.97
355.00	3.00	1,671	1524	1524	3754	3.03



$K_s =$	980.4
$b =$	1.2117

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
351.00	-1.00	678				
352.00	0.00	911				Sediment Storage
353.00	1.00	1,169	1040	1040	1040	1.01
354.00	2.00	1,452	1311	1311	2351	1.97
355.00	3.00	1,760	1606	1606	3957	3.03



$K_s =$	1033.1
$b =$	1.2119

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool=	47,013	cf
Volume of Forebay below Normal Pool=	7,711	cf
Total Volume Below Normal Pool =	54,723	cf
Total Volume Above Normal Pool=	166,529	cf
Total Volume of Facility =	221,252	cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume =	47,013	cf
Provided Forebay Volume =	7,711	cf
Provided Forebay Volume % =	16%	

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool =	47,013	cf
Main Pool Area at Normal Pool =	14,351	sf
Average Depth =	3.28	ft

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond = 17.20 acres
Total impervious area to pond = 9.99 acres

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **17.20** acres @ **58.1%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = **3.28** feet (*Hard Coded*)

	3.0	3.28	4.0
Lower Boundary =>	50.0	1.79	1.51
Site % impervious =>	58.1	2.03	1.72
Upper Boundary =>	60.0	2.09	1.77

Therefore, SA/DA required = **1.95**

Surface area required for main pool at normal pool = 14,578 ft²
= 0.33 acres

Surface area provided for total normal pool = 19,072 ft²

Surface area estimate for main pool at normal pool = 14,351 ft²

DETERMINATION OF WATER QUALITY VOLUME

$$WQ_V = (P)(R_V)(A)/12$$

where,

WQ_V = water quality volume (in acre-ft)

$R_V = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	17.20	acres
Impervious area =	9.99	acres
Percent impervious cover, I =	58.1	%
Rainfall, P =	1.00	inches

Calculated values:

$R_V =$	0.57	
$WQ_V =$	0.82	acre-ft
=	35748	cf.

ASSOCIATED DEPTH IN POND

$$WQ_V = 35748 \text{ cf.}$$

Stage / Storage Data:

$K_s =$	20933	
$b =$	1.148	
$Z_o =$	355.00	
Volume in 1" rainfall =	35748	cf.

Calculated values:

Depth of WQv in Basin =	1.59	ft
=	19.13	inches
Elevation =	356.59	ft

DRAWDOWN ORIFICE DESIGN

D orifice =	3 inch
# orifices =	1
Ks =	20933
b =	1.1480
C _d orifice =	0.60
Normal Pool Elevation =	355.00 feet
Volume @ Normal Pool =	0 cf
Orifice Invert =	355.00 feet
WSEL @ 1" Runoff Volume =	356.59 feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
356.59	35748	0.286			
356.46	32219	0.272	0.279	3528	12640
356.32	28740	0.258	0.265	3479	13129
356.18	25315	0.242	0.250	3425	13698
356.04	21948	0.226	0.234	3367	14376
355.90	18647	0.208	0.217	3301	15202
355.77	15420	0.189	0.199	3227	16247
355.63	12278	0.167	0.178	3142	17633
355.49	9237	0.143	0.155	3041	19615
355.35	6322	0.113	0.128	2915	22850
355.21	3575	0.067	0.090	2747	30689

Drawdown Time =	2.04 days
-----------------	-----------

By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.490 feet
Orifice composite loss coefficient =	0.600
Cross-sectional area of siphon =	0.049 sf

Q = 0.1654 cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.50 days
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Subsection: Elevation-Area Volume Curve

Label: SCM E

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ac-ft)	Volume (Total) (ac-ft)
355.00	0.0	19,072	0	0.000	0.000
356.00	0.0	23,339	63,509	0.486	0.486
357.00	0.0	25,557	73,319	0.561	1.047
358.00	0.0	27,831	80,058	0.613	1.660
359.00	0.0	30,162	86,966	0.665	2.325
360.00	0.0	32,550	94,045	0.720	3.045
361.00	0.0	34,994	101,294	0.775	3.820



Subsection: Outlet Input Data

Label: SCME

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	355.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	361.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 1yr	Forward	Culvert	357.00	361.00
Inlet Box	Riser	Forward	Culvert	359.00	361.00
Orifice-Circular	WQOrifice	Forward	Culvert	355.00	361.00
Culvert-Circular	Culvert	Forward	TW	354.00	361.00
Tailwater Settings	Tailwater			(N/A)	(N/A)



Subsection: Outlet Input Data

Label: SCME

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Culvert	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	36.00 in
Length	47.95 ft
Length (Computed Barrel)	47.96 ft
Slope (Computed)	0.021 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0
Kb	0
Kr	0
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	357.25 ft	T1 Flow	42.9 ft ³ /s
T2 Elevation	357.56 ft	T2 Flow	49.0 ft ³ /s


MCADAMS

Subsection: Outlet Input Data

Label: SCME

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID: Riser	
Structure Type: Inlet Box	
Number of Openings	1
Elevation	359.00 ft
Orifice Area	16.0 ft ²
Orifice Coefficient	1
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False
Structure ID: WQOrifice	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	355.00 ft
Orifice Diameter	3.00 in
Orifice Coefficient	1
Structure ID: Orifice - 1yr	
Structure Type: Orifice-Area	
Number of Openings	2
Elevation	357.00 ft
Orifice Area	1.5 ft ²
Top Elevation	357.50 ft
Datum Elevation	357.25 ft
Orifice Coefficient	1
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.0 ft ³ /s
Flow Tolerance (Maximum)	10.0 ft ³ /s

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
355.00	0.0	(N/A)	0.00	(no Q: Orifice - 1yr,Riser,WQOrifice,Culvert)
355.10	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.20	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.40	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.50	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.60	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.70	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.80	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
355.90	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.10	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.20	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.30	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.40	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.50	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.60	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.70	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.80	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
356.90	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
357.00	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Orifice - 1yr,Riser)
357.10	1.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.20	3.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.30	4.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)

Subsection: Composite Rating Curve

Label: SCME

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
357.40	6.1	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.50	7.6	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.60	8.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.70	10.0	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.80	11.1	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
357.90	12.0	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.00	12.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.10	13.7	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.20	14.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.30	15.2	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.40	15.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.50	16.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.60	17.1	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.70	17.8	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.80	18.4	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
358.90	18.9	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
359.00	19.5	(N/A)	0.00	Orifice - 1yr,WQOrifice,Culvert (no Q: Riser)
359.10	21.5	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert

Subsection: Composite Rating Curve

Label: SCME

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
359.20	24.9	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.30	29.0	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.40	33.7	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.50	39.0	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.60	44.1	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.70	49.2	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.80	54.5	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
359.90	59.6	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.00	64.7	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.10	69.8	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.20	74.6	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.30	79.1	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.40	82.5	(N/A)	0.00	Orifice - 1yr,Riser,WQOrifice,Culvert
360.50	83.9	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
360.60	84.8	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
360.70	85.7	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
360.80	86.6	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
360.90	87.5	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)
361.00	88.4	(N/A)	0.00	Riser,Culvert (no Q: Orifice - 1yr,WQOrifice)



Subsection: Level Pool Pond Routing Summary

Label: SCM E (IN)

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	355.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	50.1 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	6.0 ft ³ /s	Time to Peak (Flow, Outlet)	754.00 min

Elevation (Water Surface, Peak)	357.39 ft
Volume (Peak)	1.280 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	2.316 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	1.259 ac-ft
Volume (Retained)	1.056 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM E (IN)

Scenario: Post-Dev 2 yr

Return Event: 2 years

Storm Event: 2 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	355.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	63.9 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	10.7 ft³/s	Time to Peak (Flow, Outlet)	753.00 min

Elevation (Water Surface, Peak)	357.77 ft
Volume (Peak)	1.513 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.073 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.008 ac-ft
Volume (Retained)	1.064 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary
Label: SCM E (IN)
Scenario: Post-Dev 10 yr

Return Event: 10 years
Storm Event: 10 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	355.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	93.5 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	20.5 ft³/s	Time to Peak (Flow, Outlet)	752.00 min

Elevation (Water Surface, Peak)	359.05 ft
Volume (Peak)	2.358 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	5.189 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	4.108 ac-ft
Volume (Retained)	1.079 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM E (IN)

Scenario: Post-Dev 25 yr

Return Event: 25 years

Storm Event: 25 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	355.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	108.5 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	36.6 ft³/s	Time to Peak (Flow, Outlet)	730.00 min

Elevation (Water Surface, Peak)	359.45 ft
Volume (Peak)	2.646 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	6.496 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	5.409 ac-ft
Volume (Retained)	1.085 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM E (IN)

Scenario: Post-Dev 100 yr

Return Event: 100 years

Storm Event: 100 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	355.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	130.0 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	63.7 ft ³ /s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	359.98 ft
Volume (Peak)	3.030 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	8.681 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	7.592 ac-ft
Volume (Retained)	1.086 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



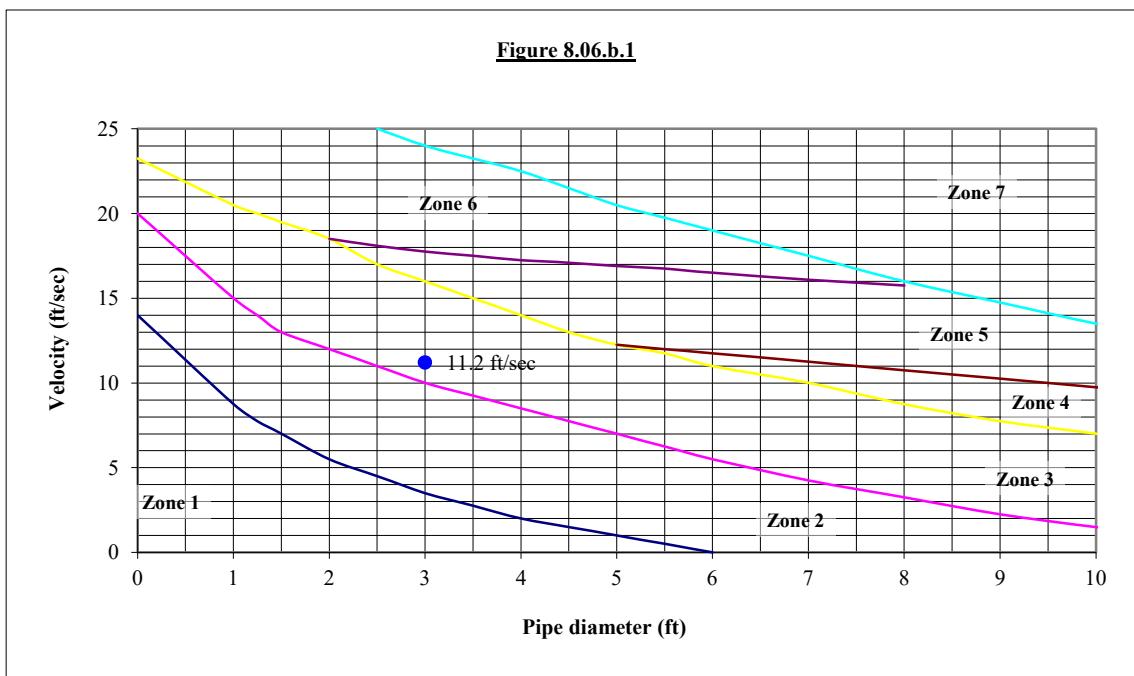
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DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	<u>The Point</u>	Date	<u>11/23/2020</u>
Project No.	<u>AWH-20000</u>	Designer	<u>TKD</u>
Outlet ID	<u>SCM E</u>		
Flow, $Q_{10\text{-yr}}$	<u>20.5</u> cfs		
Slope, S	<u>2.09</u> %		
Pipe Diameter, D_o	<u>36</u> inches		
Pipe Diameter, D_o	<u>3.0</u> feet		
Number of pipes	<u>1</u>		
Pipe separation	<u>0</u> feet		
Manning's n	<u>0.013</u>		



Zone from graph above = 3

Outlet pipe diameter	<u>36 in.</u>	Length =	<u>24.0 ft.</u>
Outlet flowrate	<u>20.5 cfs</u>	Width =	<u>9.0 ft.</u>
Outlet velocity	<u>11.2 ft/sec</u>	Stone diameter =	<u>13 in.</u>
Material =	<u>Class I</u>	Thickness =	<u>22 in.</u>

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	$4 \times D(o)$	$3 \times D(o)$
2	Class B	6	22	$6 \times D(o)$	$3 \times D(o)$
3	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
4	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
5	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
6	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = **1.15** (recommend 1.15 or higher)

Concrete:

Concrete unit weight = **142.0** PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = **5.00** feet
Inside length of riser = **4.00** feet
Inside width of riser = **4.00** feet
Wall thickness of riser = **6.00** inches
Base thickness of riser = **6.00** inches
Base length of riser = **5.00** feet
Base width of riser = **5.00** feet

Openings:

Total Orifice Area = **3.196** SF
OD of barrel exiting manhole = **44.00** inches
Size of drain pipe (if present) = **6.0** inches

Trash Rack:

Bottom Length = **7.00** feet
Bottom Width = **7.00** feet
Top Length = **1.00** feet
Top Width = **1.00** feet
Height = **2.00** feet
Trash Rack water displacement = **38.00** CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = **12.50** CF
Riser Walls = **45.00** CF

Adjust for openings:

Opening for Orifices = **1.60** CF
Opening for barrel = **5.28** CF
Opening for drain pipe = **0.10** CF

Total Concrete present, adjusted for openings = **50.524 CF**
Weight of concrete present = **7,174 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	50.52 CF
Displacement by open air in riser =	80.00 CF
Displacement by trash rack =	38.00 CF
Total water displaced by riser/barrel structure =	168.52 CF
Weight of water displaced =	10,516 lbs

Calculate size of base for riser assembly ==>

Length =	8.00 feet
Width =	8.00 feet
Thickness =	12 inches
Concrete Present =	64.00 CF

Check validity of base as designed ==>

Total Water Displaced =	220.02 CF
Total Concrete Present =	114.52 CF
Total Water Displaced =	13,729 lbs
Total Concrete Present =	16,262 lbs
Actual safety factor =	1.18 OK

Results of design ==>

Base length =	8.00 feet
Base width =	8.00 feet
Base Thickness =	12.00 inches
CY of concrete total in base =	2.37 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 8.0 feet
Anti-Floatation Block Width = 8.0 feet
Anti-Floatation Block Thickness = 12 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or h)

Cross-Section Calculations==>

Cross-Section Area* = 8.00 SF
Minimum Steel Area Required = 0.016 SF
2.30 SI

*Note: Assumes a "square" x-sec (L and W same)

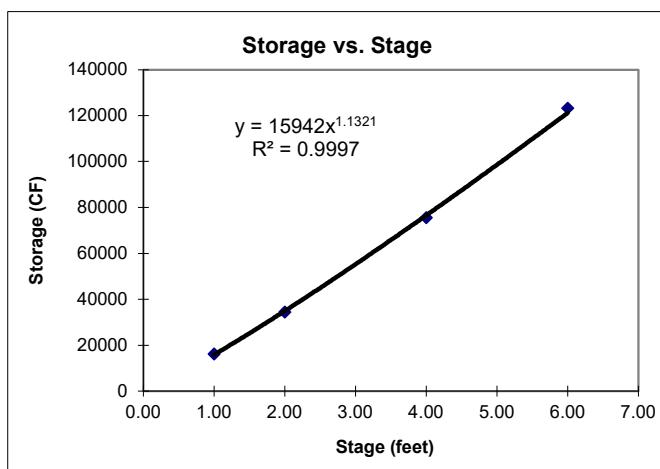
Rebar Calculations ==>

Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	12	8	6	4	3

STORMWATER CONTROL MEASURE 'F'
DESIGN CALCULATIONS

STAGE-STORAGE FUNCTION - ABOVE NORMAL POOL

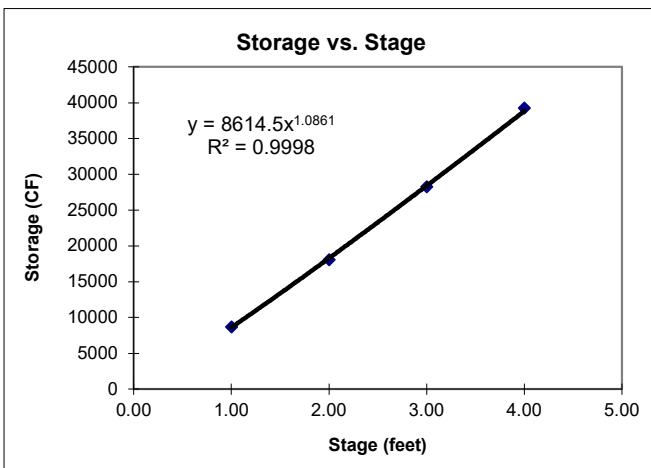
Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
344.00	0.00	14,748				
345.00	1.00	17,534	16141	16141	16141	1.01
346.00	2.00	19,012	18273	18273	34414	1.97
348.00	4.00	22,138	20575	41150	75564	3.95
350.00	6.00	25,490	23814	47628	123192	6.09



STAGE-STORAGE FUNCTION - MAIN POOL

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
339.00	-1.00	7,612				
340.00	0.00	8,311				Sediment Storage
341.00	1.00	9,035	8673	8673	8673	1.01
342.00	2.00	9,785	9410	9410	18083	1.98
343.00	3.00	10,559	10172	10172	28255	2.99
344.00	4.00	11,358	10959	10959	39214	4.04

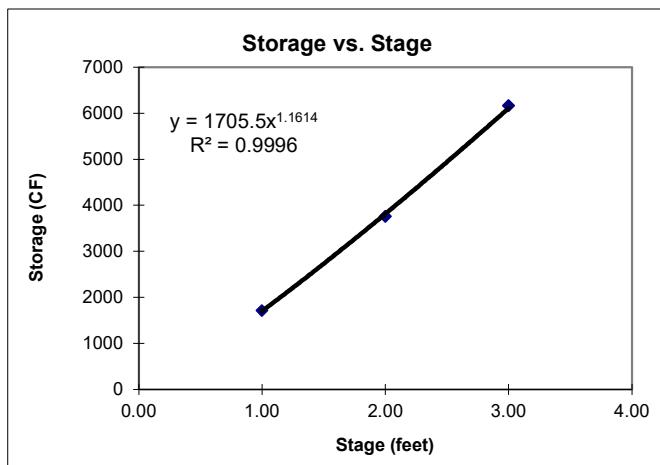
*surface area and volume used for avg. depth calculation



$$\begin{array}{ll} K_s = & 8614 \\ b = & 1.0861 \end{array}$$

STAGE-STORAGE FUNCTION - FOREBAY

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
340.00	-1.00	1,260				
341.00	0.00	1,555				Sediment Storage
342.00	1.00	1,874	1715	1715	1715	1.00
343.00	2.00	2,219	2047	2047	3761	1.98
344.00	3.00	2,588	2404	2404	6165	3.02



$K_s =$	1705.5
$b =$	1.1614

TOTAL VOLUME OF FACILITY

Volume of Main Pool below Normal Pool= 39,214 cf
Volume of Forebay below Normal Pool= 6,165 cf
Total Volume Below Normal Pool = 45,378 cf
Total Volume Above Normal Pool= 123,192 cf
Total Volume of Facility = 168,570 cf

FOREBAY PERCENTAGE OF PERMANENT POOL VOLUME

Per NCDEQ Minimum Design Criteria, the forebay volume should equal approximately 15-20% of the main pool volume.

Total Main Pool Volume = 39,214 cf
Provided Forebay Volume = 6,165 cf
Provided Forebay Volume % = 16%

AVERAGE DEPTH OF MAIN POOL

Main Pool Volume at Normal Pool = 39,214 cf
Main Pool Area at Normal Pool = 11,358 sf
Average Depth = **3.45** ft

WET DETENTION BASIN SUMMARY

Enter the drainage area characteristics ==>

Total drainage area to pond = 18.53 acres
Total impervious area to pond = 9.80 acres

****Values represent full buildout****

Note The basin must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **18.53** acres @ **52.9%** impervious

Estimate the surface area required at pond normal pool elevation ==>

Wet Detention Basins are based on an minimum average depth of = **3.45** feet (*Hard Coded*)

	3.0	3.45	4.0
Lower Boundary =>	50.0	1.79	1.51
Site % impervious =>	52.9	1.88	1.59
Upper Boundary =>	60.0	2.09	1.77

Therefore, SA/DA required = **1.74**

Surface area required for main pool at normal pool = 14,086 ft²
= 0.32 acres

Surface area provided for total normal pool = 14,748 ft²

Surface area estimate for main pool at normal pool = 11,358 ft²

DETERMINATION OF WATER QUALITY VOLUME

$$WQ_V = (P)(R_V)(A)/12$$

where,

WQ_V = water quality volume (in acre-ft)

$R_V = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	18.53	acres
Impervious area =	9.80	acres
Percent impervious cover, I =	52.9	%
Rainfall, P =	1.00	inches

Calculated values:

$R_V =$	0.53	
$WQ_V =$	0.81	acre-ft
=	35388	cf.

ASSOCIATED DEPTH IN POND

$$WQ_V = 35388 \text{ cf.}$$

Stage / Storage Data:

$K_s =$	15942	
$b =$	1.132	
$Z_o =$	344.00	
Volume in 1" rainfall =	35388	cf.

Calculated values:

Depth of WQv in Basin =	2.02	ft
=	24.27	inches
Elevation =	346.02	ft

DRAWDOWN ORIFICE DESIGN

D orifice =	2.75 inch
# orifices =	1
Ks =	15942
b =	1.1321
C _d orifice =	0.60
Normal Pool Elevation =	344.00 feet
Volume @ Normal Pool =	0 cf
Orifice Invert =	344.00 feet
WSEL @ 1" Runoff Volume =	346.02 feet

WSEL (feet)	Vol. Stored (cf)	Orifice Flow (cfs)	Avg. Flow (cfs)	Incr. Vol. (cf)	Incr. Time (sec)
346.02	35388	0.274			
345.85	31927	0.261	0.267	3462	12944
345.67	28508	0.247	0.254	3418	13449
345.50	25137	0.233	0.240	3371	14036
345.32	21818	0.218	0.225	3319	14731
345.14	18557	0.201	0.209	3261	15573
344.97	15362	0.183	0.192	3195	16629
344.79	12243	0.163	0.173	3119	18010
344.62	9215	0.140	0.152	3028	19946
344.44	6300	0.113	0.127	2915	22985
344.26	3539	0.077	0.095	2761	29067

Drawdown Time =	2.05 days
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By comparison, if calculated by the average head over the orifice
(assuming average head is one-third the total depth), the result would be:

Average driving head on orifice =	0.636 feet
Orifice composite loss coefficient =	0.600
Cross-sectional area of siphon =	0.041 sf

Q = 0.1584 cfs

Drawdown Time = Volume / Flowrate / 86400 (sec/day)

Drawdown Time =	2.59 days
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Subsection: Elevation-Area Volume Curve

Label: SCM F

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ac-ft)	Volume (Total) (ac-ft)
344.00	0.0	14,748	0	0.000	0.000
345.00	0.0	17,534	48,363	0.370	0.370
346.00	0.0	19,012	54,804	0.419	0.789
347.00	0.0	20,547	59,324	0.454	1.243
348.00	0.0	22,138	64,013	0.490	1.733
349.00	0.0	23,786	68,871	0.527	2.260
350.00	0.0	25,490	73,899	0.565	2.826



Subsection: Outlet Input Data

Label: SCMF

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	344.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	350.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir - 1yr	Forward	Culvert	346.25	350.00
Inlet Box	Riser	Forward	Culvert	347.50	350.00
Orifice-Circular	WQOrifice	Forward	Culvert	344.00	350.00
Culvert-Circular	Culvert	Forward	TW	342.50	350.00
Tailwater Settings	Tailwater			(N/A)	(N/A)



Subsection: Outlet Input Data

Label: SCMF

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Structure ID:	Culvert
Structure Type:	Culvert-Circular
Number of Barrels	1
Diameter	48.00 in
Length	47.58 ft
Length (Computed Barrel)	47.65 ft
Slope (Computed)	0.053 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0
Kb	0
Kr	0
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1
T2 ratio (HW/D)	1
Slope Correction Factor	-1

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	346.78 ft	T1 Flow	88.0 ft ³ /s
T2 Elevation	347.18 ft	T2 Flow	100.5 ft ³ /s



Subsection: Outlet Input Data

Label: SCMF

Scenario: Post-Dev 1 yr

Return Event: 1 years
Storm Event: 1 yr

Structure ID: Riser	
Structure Type: Inlet Box	
Number of Openings	1
Elevation	347.50 ft
Orifice Area	36.0 ft ²
Orifice Coefficient	1
Weir Length	12.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1
Manning's n	0
Kev, Charged Riser	0
Weir Submergence	False
Orifice H to crest	False
Structure ID: WQOrifice	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	344.00 ft
Orifice Diameter	2.75 in
Orifice Coefficient	1
Structure ID: Weir - 1yr	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	346.25 ft
Weir Length	12.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.0 ft ³ /s
Flow Tolerance (Maximum)	10.0 ft ³ /s

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
344.00	0.0	(N/A)	0.00	(no Q: Weir - 1yr,Riser,WQOrifice,Culvert)
344.10	0.0	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.20	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.30	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.40	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.50	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.60	0.1	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.70	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.80	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
344.90	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.00	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.10	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.20	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.30	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.40	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.50	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.60	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.70	0.2	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.80	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
345.90	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
346.00	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
346.10	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
346.20	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
346.25	0.3	(N/A)	0.00	WQOrifice,Culvert (no Q: Weir - 1yr,Riser)
346.30	0.7	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)



Subsection: Composite Rating Curve

Label: SCMF

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
346.40	2.4	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
346.50	4.8	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
346.60	7.8	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
346.70	11.2	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
346.80	15.0	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
346.90	19.2	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.00	23.7	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.10	28.5	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.20	33.6	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.30	39.0	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.40	44.7	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.50	50.6	(N/A)	0.00	Weir - 1yr,WQOrifice,Culvert (no Q: Riser)
347.60	57.8	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
347.70	66.3	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
347.80	74.1	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
347.90	81.2	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.00	87.9	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.10	94.5	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
348.20	100.8	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.30	106.8	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.40	112.6	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.50	117.6	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.60	121.6	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.70	125.3	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.80	128.8	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
348.90	132.0	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.00	134.8	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.10	137.5	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.20	139.9	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.30	142.2	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.40	144.3	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.50	146.4	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.60	148.3	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.70	150.2	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.80	151.9	(N/A)	0.00	Weir - 1yr,Riser,WQOrifice,Culvert
349.90	153.7	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1yr,WQOrifice)



Subsection: Composite Rating Curve

Label: SCMF

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
350.00	155.4	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1yr,WQOrifice)



Subsection: Level Pool Pond Routing Summary

Label: SCM F (IN)

Scenario: Post-Dev 1 yr

Return Event: 1 years

Storm Event: 1 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	344.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	73.6 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	33.1 ft ³ /s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	347.19 ft
Volume (Peak)	1.334 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	3.403 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	2.479 ac-ft
Volume (Retained)	0.923 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM F (IN)

Scenario: Post-Dev 2 yr

Return Event: 2 years

Storm Event: 2 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	344.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	92.1 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	56.9 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	347.59 ft
Volume (Peak)	1.527 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	4.451 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	3.520 ac-ft
Volume (Retained)	0.930 ac-ft
Volume (Unrouted)	-0.001 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary
Label: SCM F (IN)
Scenario: Post-Dev 10 yr

Return Event: 10 years
Storm Event: 10 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	344.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	131.2 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	97.2 ft³/s	Time to Peak (Flow, Outlet)	725.00 min

Elevation (Water Surface, Peak)	348.14 ft
Volume (Peak)	1.806 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	7.347 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	6.402 ac-ft
Volume (Retained)	0.943 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM F (IN)

Scenario: Post-Dev 25 yr

Return Event: 25 years

Storm Event: 25 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	344.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft³/s
Flow (Initial Infiltration)	0.0 ft³/s
Flow (Initial, Total)	0.0 ft³/s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	150.7 ft³/s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	111.4 ft³/s	Time to Peak (Flow, Outlet)	725.00 min

Elevation (Water Surface, Peak)	348.38 ft
Volume (Peak)	1.928 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	9.123 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	8.173 ac-ft
Volume (Retained)	0.948 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



Subsection: Level Pool Pond Routing Summary

Label: SCM F (IN)

Scenario: Post-Dev 100 yr

Return Event: 100 years

Storm Event: 100 yr

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Water Surface, Initial)	344.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.0 ft ³ /s
Flow (Initial Infiltration)	0.0 ft ³ /s
Flow (Initial, Total)	0.0 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	178.7 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	126.8 ft ³ /s	Time to Peak (Flow, Outlet)	725.00 min

Elevation (Water Surface, Peak)	348.74 ft
Volume (Peak)	2.121 ac-ft

Mass Balance (ac-ft)

Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	12.081 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	11.129 ac-ft
Volume (Retained)	0.949 ac-ft
Volume (Unrouted)	-0.002 ac-ft
Error (Mass Balance)	0.0 %



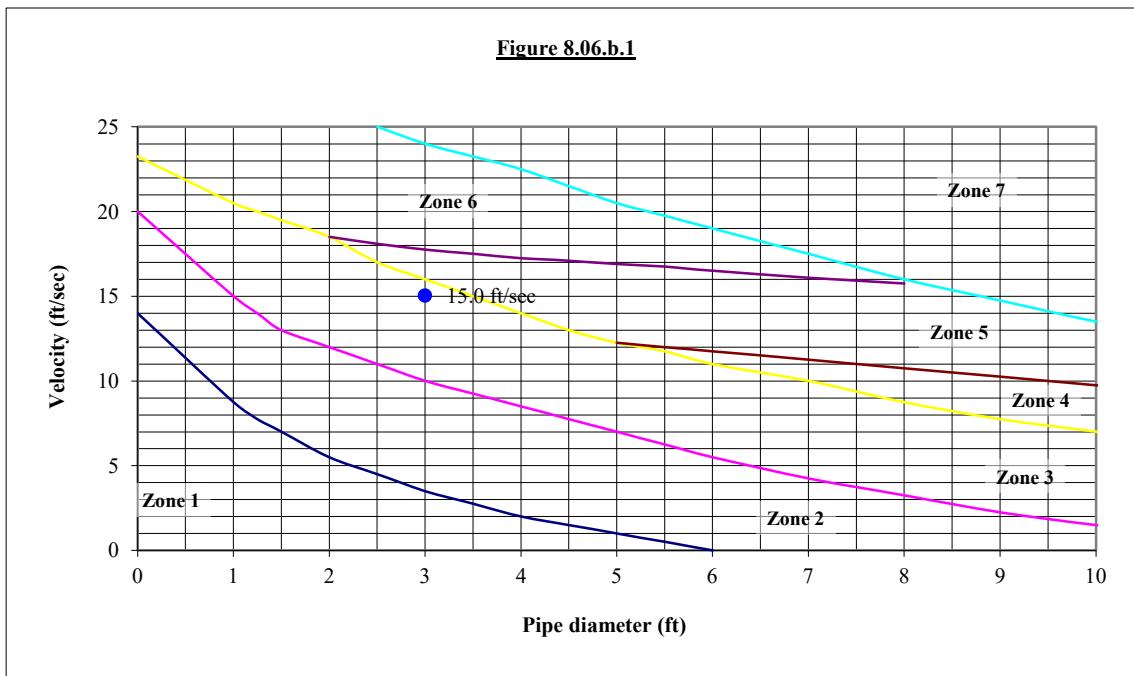
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- SCM F (Elevation-Area Volume Curve, 1 years (Post-Dev 1 yr))...1
- SCM F (IN) (Level Pool Pond Routing Summary, 1 years (Post-Dev 1 yr))...9
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- SCM F (IN) (Level Pool Pond Routing Summary, 100 years (Post-Dev 100 yr))...13
- SCM F (IN) (Level Pool Pond Routing Summary, 2 years (Post-Dev 2 yr))...10
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- SCMF (Composite Rating Curve, 1 years (Post-Dev 1 yr))...5, 6, 7, 8
- SCMF (Outlet Input Data, 1 years (Post-Dev 1 yr))...2, 3, 4

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project	<u>The Point</u>	Date	<u>11/23/2020</u>
Project No.	<u>AWH-20000</u>	Designer	<u>TKD</u>
Outlet ID	<u>SCM F</u>		
Flow, $Q_{10\text{-yr}}$	<u>97.2</u> cfs		
Slope, S	<u>2.09</u> %		
Pipe Diameter, D_o	<u>36</u> inches		
Pipe Diameter, D_o	<u>3.0</u> feet		
Number of pipes	<u>1</u>		
Pipe separation	<u>0</u> feet		
Manning's n	<u>0.013</u>		



Zone from graph above = 3

Outlet pipe diameter	<u>36 in.</u>	Length =	<u>24.0 ft.</u>
Outlet flowrate	<u>97.2 cfs</u>	Width =	<u>9.0 ft.</u>
Outlet velocity	<u>15.0 ft/sec</u>	Stone diameter =	<u>13 in.</u>
Material =	<u>Class I</u>	Thickness =	<u>22 in.</u>

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	$4 \times D(o)$	$3 \times D(o)$
2	Class B	6	22	$6 \times D(o)$	$3 \times D(o)$
3	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
4	Class I	13	22	$8 \times D(o)$	$3 \times D(o)$
5	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
6	Class II	23	27	$10 \times D(o)$	$3 \times D(o)$
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
2. Outlet velocity based on full-flow velocity

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = **1.15** (recommend 1.15 or higher)

Concrete:

Concrete unit weight = **142.0** PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = **5.00** feet
Inside length of riser = **6.00** feet
Inside width of riser = **6.00** feet
Wall thickness of riser = **6.00** inches
Base thickness of riser = **6.00** inches
Base length of riser = **7.00** feet
Base width of riser = **7.00** feet

Openings:

Total Orifice Area = **4.665** SF
OD of barrel exiting manhole = **58.00** inches
Size of drain pipe (if present) = **6.0** inches

Trash Rack:

Bottom Length = **9.60** feet
Bottom Width = **9.60** feet
Top Length = **2.00** feet
Top Width = **2.00** feet
Height = **2.00** feet
Trash Rack water displacement = **76.91** CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = **24.50** CF
Riser Walls = **65.00** CF

Adjust for openings:

Opening for Orifices = **2.33** CF
Opening for barrel = **9.17** CF
Opening for drain pipe = **0.10** CF

Total Concrete present, adjusted for openings = **77.895 CF**
Weight of concrete present = **11,061 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	77.90 CF
Displacement by open air in riser =	180.00 CF
Displacement by trash rack =	76.91 CF
Total water displaced by riser/barrel structure =	334.80 CF
Weight of water displaced =	20,892 lbs

Calculate size of base for riser assembly ==>

Length =	10.00 feet
Width =	10.00 feet
Thickness =	24 inches
Concrete Present =	200.00 CF

Check validity of base as designed ==>

Total Water Displaced =	510.30 CF
Total Concrete Present =	277.90 CF
Total Water Displaced =	31,843 lbs
Total Concrete Present =	39,461 lbs
Actual safety factor =	1.24 OK

Results of design ==>

Base length =	10.00 feet
Base width =	10.00 feet
Base Thickness =	24.00 inches
CY of concrete total in base =	7.41 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 10.0 feet
Anti-Floatation Block Width = 10.0 feet
Anti-Floatation Block Thickness = 24 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or h)

Cross-Section Calculations==>

Cross-Section Area* = 20.00 SF
Minimum Steel Area Required = 0.040 SF
5.76 SI

*Note: Assumes a "square" x-sec (L and W same)

Rebar Calculations ==>

Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars	30	19	14	10	8

CULVERT DESIGN CALCULATIONS

Culvert #1				
	10yr	25yr	100yr	
Subbasin 1	18.04	22.06	28.46	cfs
Total	18.04	22.06	28.46	cfs

CULVERT #1 DESIGN CALCULATIONS

Q10, Peak = **18.04** cfs
Q25, Peak = **22.06** cfs
Q100, Peak = **28.46** cfs

25-Year Storm

Culvert Size = **3** ft
Number of Barrels = **1**
US Pipe Invert = **378.00** ft
Embedment = **0.67** ft
25-Year WS = **381.08** ft
Hw/D = **1.0**
Road Crest = **386.54** ft
Freeboard = **5.46** ft

100-Year Storm

Culvert Size = **3** ft
Number of Barrels = **1**
Pipe Invert = **378.00** ft
Embedment = **0.67** ft
100-Year WS = **381.88** ft
Hw/D = **1.4**
Road Crest = **386.54** ft
Freeboard = **4.66** ft

Minimum Required Velocity Dissipator

Length = **18.00** ft
Width = **9.00** ft
Thickness = **18.00** in
Classification = Class B

Barrel Information

Length = **59.00** ft
Invert Out = **377.50** ft
Slope = **0.85%**

THE POINT
AWH20000

CULVERT HYDROLOGY
Subbasin MARVEL DRIVE

T. DABOLT
11/25/2020

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume:
 HSG 'A' = 0.0%
 HSG 'B' = 0.0%
 HSG 'C' = 68.2%
 HSG 'D' = 31.9%

** Included water area in HSG D**

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	76	Assume good condition
Wooded	72	Assume good condition

II. POST-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [ac]
Roadway Area	959	0.02
Driveway / Parking Lot	0	0.00
Roof	0	0.00
Sidewalk / Patio	2,960	0.07
Other	0	0.00
Totals	3,919	0.09

B. Watershed Land Use Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	0	0.00	-
Onsite open	76	246,160	5.65	Assume good condition
Onsite wooded	72	0	0.00	Assume good condition
Onsite pond	100	98,753	2.27	-
Offsite impervious	98	27,660	0.63	-
Offsite open	76	0	0.00	Assume good condition
Offsite wooded	72	0	0.00	Assume good condition
Offsite pond	100	0	0.00	-
Total area =	8.55	acres		
		372,573	sf	
Composite SCS CN =	84			
% Impervious =	7.4%			

C. Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	411.00	ft
Bot Elev =	408.00	ft
Height =	3	ft
Slope =	0.0300	ft/ft
Manning's n =	0.40	wooded-dense underbrush
P (2-year/24-hour) =	3.46	inches (Wake Forest, NC)
Segment Time =	17.56	minutes

Segment 2: Overland Flow

Length =	253	ft
Top Elev =	408.00	ft
Bot Elev =	398.10	ft
Height =	10	ft
Slope =	0.0391	ft/ft
Manning's n =	0.40	wooded-dense underbrush
P (2-year/24-hour) =	3.46	inches (Wake Forest, NC)
Segment Time =	33.18	minutes

Segment 5: Pipe Flow

Length =	143	ft
Top Elev =	398.10	
Bot Elev =	392.00	
Height =	6.1	ft
Slope =	0.0427	ft/ft
Manning's n =	0.013	concrete pipe
Pipe Diameter=	1.25	ft
Flow Area =	1.23	sf
Wetted Perimeter =	3.93	If (2 ft ID pipe)
Channel Velocity =	10.90	ft/sec
Segment Time =	0.22	minutes

Segment 3: Concentrated Flow

Length =	650	ft
Top Elev =	392.00	ft
Bot Elev =	382.00	ft
Height =	10	ft
Slope =	0.0154	ft/ft
Paved ? =	No	
Velocity =	2.00	ft/sec
Segment Time =	5.41	minutes

Segment 4: Channel Flow

Length =	117	ft
Top Elev =	382.00	
Bot Elev =	378.00	
Height =	4	ft
Slope =	0.0342	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	4.00	sf (assume 2' x 2' channel)
Wetted Perimeter =	6.00	If (assume 2' x 2' channel)
Channel Velocity =	4.67	ft/sec
Segment Time =	0.42	minutes

Time of Concentration =	56.79	minutes
SCS Lag Time =	34.07	minutes (SCS Lag = 0.6* Tc)
Time Increment =	9.88	minutes (= 0.29*SCS Lag)

FlexTable: Catchment Table (Culvert - 1.ppc)

Current Time: 0.00 min

Label	Area (acres)	SCS CN	Time of Concentration (min)	Notes
Marvel Drive Culvert	10.72	84	56.79	

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)
Marvel Drive Culvert	Post-Development 10 year	10	2.926	756.00	18.04
Marvel Drive Culvert	Post-Development 25 year	25	3.715	756.00	22.06
Marvel Drive Culvert	Post-Development 100 year	100	5.050	756.00	28.46

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)
O-1	Post-Development 10 year	10	2.926	756.00	18.04
O-1	Post-Development 25 year	25	3.715	756.00	22.06
O-1	Post-Development 100 year	100	5.050	756.00	28.46

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 18.04 cfs

Design Flow: 22.06 cfs

Maximum Flow: 28.46 cfs

Table 1 - Summary of Culvert Flows at Crossing: Marvel Drive

Headwater Elevation	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
380.76	18.04	18.04	0.00	1
380.84	19.08	19.08	0.00	1
380.92	20.12	20.12	0.00	1
381.01	21.17	21.17	0.00	1
381.08	22.06	22.06	0.00	1
381.18	23.25	23.25	0.00	1
381.27	24.29	24.29	0.00	1
381.36	25.33	25.33	0.00	1
381.47	26.38	26.38	0.00	1
381.66	27.42	27.42	0.00	1
381.88	28.46	28.46	0.00	1
386.54	51.70	51.70	0.00	Overtopping

Rating Curve Plot for Crossing: Marvel Drive

Total Rating Curve

Crossing: Marvel Drive

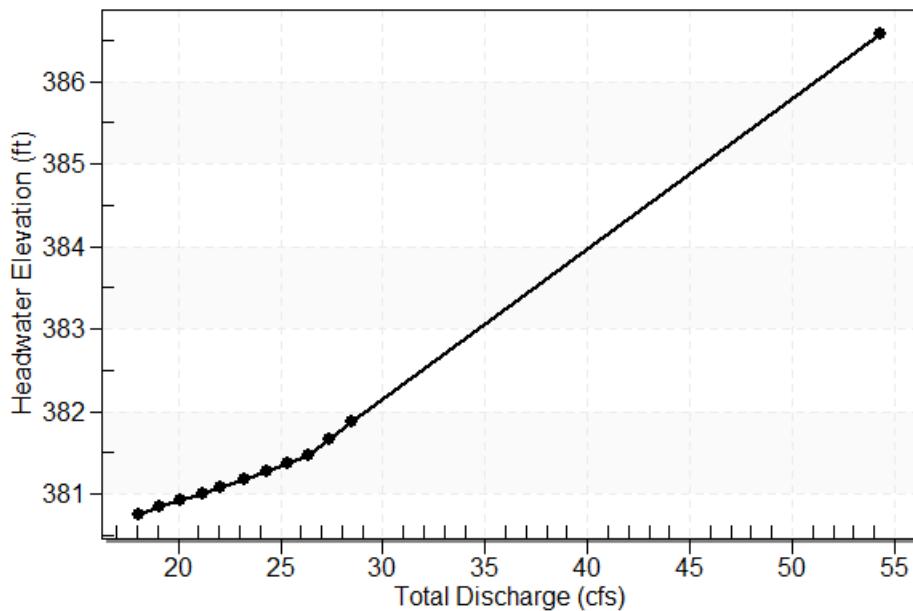


Table 2 - Culvert Summary Table: Culvert 1

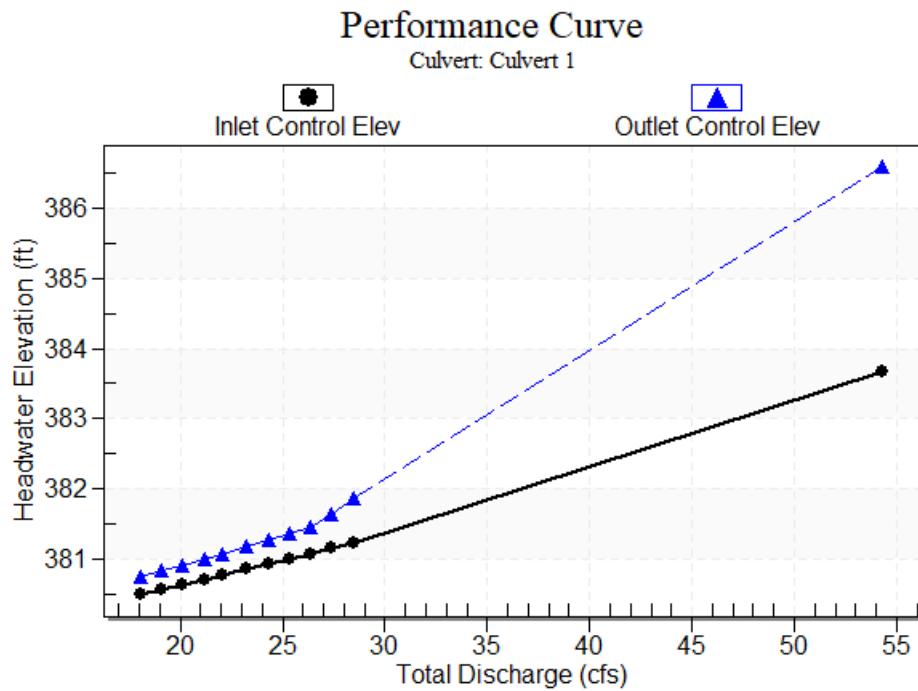
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
18.04	18.04	380.76	1.838	2.090	2-M2	1.954	1.086	1.086	0.351	5.814	3.186
19.08	19.08	380.84	1.909	2.173	2-M2	2.069	1.124	1.124	0.363	5.935	3.252
20.12	20.12	380.92	1.979	2.257	2-M2	2.245	1.161	1.161	0.374	6.055	3.315
21.17	21.17	381.01	2.050	2.340	7-M2	2.333	1.197	1.197	0.386	6.172	3.377
22.06	22.06	381.08	2.112	2.414	7-M2	2.333	1.228	1.228	0.395	6.270	3.428
23.25	23.25	381.18	2.194	2.513	7-M2	2.333	1.269	1.269	0.408	6.397	3.494
24.29	24.29	381.27	2.268	2.603	7-M2	2.333	1.304	1.304	0.418	6.505	3.549
25.33	25.33	381.36	2.343	2.698	7-M2	2.333	1.338	1.338	0.429	6.611	3.604
26.38	26.38	381.47	2.420	2.799	7-M2	2.333	1.371	1.371	0.439	6.722	3.656
27.42	27.42	381.66	2.498	2.989	7-M2	2.333	1.403	1.403	0.449	6.834	3.707
28.46	28.46	381.88	2.578	3.213	7-M2	2.333	1.434	1.434	0.459	6.944	3.757

Straight Culvert

Inlet Elevation (invert): 378.67 ft, Outlet Elevation (invert): 378.17 ft

Culvert Length: 59.00 ft, Culvert Slope: 0.0085

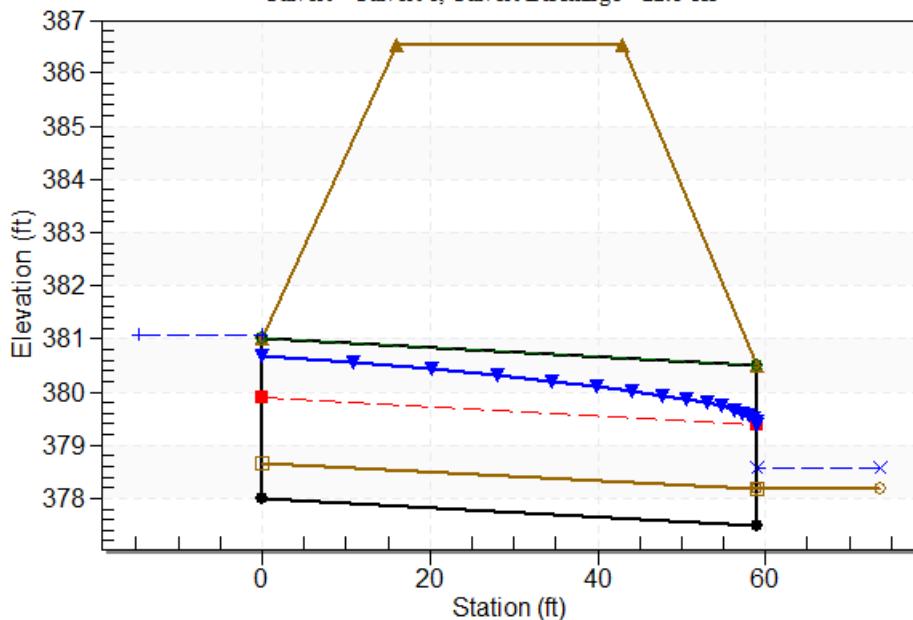
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1

Crossing - Marvel Drive, Design Discharge - 22.1 cfs

Culvert - Culvert 1, Culvert Discharge - 22.1 cfs



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 378.00 ft

Outlet Station: 59.00 ft

Outlet Elevation: 377.50 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 8.00 in

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0450 (bottom)

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Marvel Drive)

Flow (cfs)	Water Surfac Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
18.04	378.52	0.35	3.19	0.91	0.98
19.08	378.53	0.36	3.25	0.94	0.99
20.12	378.54	0.37	3.32	0.97	0.99
21.17	378.56	0.39	3.38	1.00	1.00
22.06	378.57	0.40	3.43	1.03	1.00
23.25	378.58	0.41	3.49	1.06	1.00
24.29	378.59	0.42	3.55	1.09	1.01
25.33	378.60	0.43	3.60	1.12	1.01
26.38	378.61	0.44	3.66	1.14	1.02
27.42	378.62	0.45	3.71	1.17	1.02
28.46	378.63	0.46	3.76	1.19	1.02

Tailwater Channel Data - Marvel Drive

Tailwater Channel Option: Irregular Channel

Roadway Data for Crossing: Marvel Drive

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 386.54 ft

Roadway Surface: Paved

Roadway Top Width: 27.00 ft

DESIGN OF RIPRAP OUTLET PROTECTION

New York DOT Dissipator Method For Use in Defined Channels

(Source: "Bank and channel lining procedures", New York Department of Transportation, Division of Design and Construction, 1971.)

Guide to Color Key:	User Input Data	Calculated Value	Reference Data
Designed By: TKD	Date: 11/19/2020		
Checked By: DCW	Date: 11/19/2020		
Company: McAdams			
Project Name: The Point			
Project No.: AWH-20000			
Site Location (City/Town) Rolesville, NC			
Culvert Id. Culvert 1			

Estimation of Stone Size and Dimensions For Culvert Aprons

Step 1) Compute flow velocity V_o at culvert or paved channel outlet.

Step 2) For pipe culverts D_o is diameter.

For pipe arch, arch and box culverts, and paved channel outlets,
 $D_o = A_o$ where A_o = cross-sectional area of flow at outlet.

For multiple culverts, use $D_o = 1.25 \times D_o$ of single culvert.

Velocity (ft/s)	6.27
Opening type	Pipe Culvert
Single or multiple openings?	Single
Outlet pipe diameter, D_o (ft)	3.0

NOTE 1: If opening type is anything other than "Pipe Culvert", $D_o = A_o$
(Cross-sectional area of flow at outlet).

NOTE 2: If multiple openings, $D_o = 1.25 \times D_o$ of single culvert.

Step 3) For apron grades of 10% or steeper, use recommendations
For next higher zone. (Zones 1 through 6).

Zone:	2	Figure 8.06c
Will apron have $>/= 10\%$ grade?	No	

NOTE: For apron slopes equal to or greater than 10%, use next higher Zone in Figure 8.06d to determine apron length.

USE:	Class B	
Apron length (ft) =	18	Figure 8.06d
Apron width (ft) =	9	
Riprap Depth (ft) =	1.50	

Determination of Stone Sizes For Dumped Stone Channel Linings and Revetments

Step 1. Use figure 8.06e³ to determine maximum stone size (e.g. for 12 Fps = 20" or 550 lbs.

Max. stone size (in.) 6 [Figure 8.06e](#)

Step 2. Use figure 8.06f⁴ to determine acceptable size range for stone (for 12 FPS it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.).

NOTE: In determining channel velocities for stone linings and revetment, use the following coefficients of roughness:

	Diameter (inches)	Manning's "n"	Min. thickness of lining	(inches)
Fine	3	0.031	9	12
Light	6	0.035	12	18
Medium	13	0.040	18	24
Heavy	23	0.044	30	36

(Channels) (Dissapators)

Min. & max range of stones (lbs) 25-150 [Figure 8.05f](#)
Weight range of 75% of stones (lbs) 50-150 [Figure 8.05f](#)



MCADAMS

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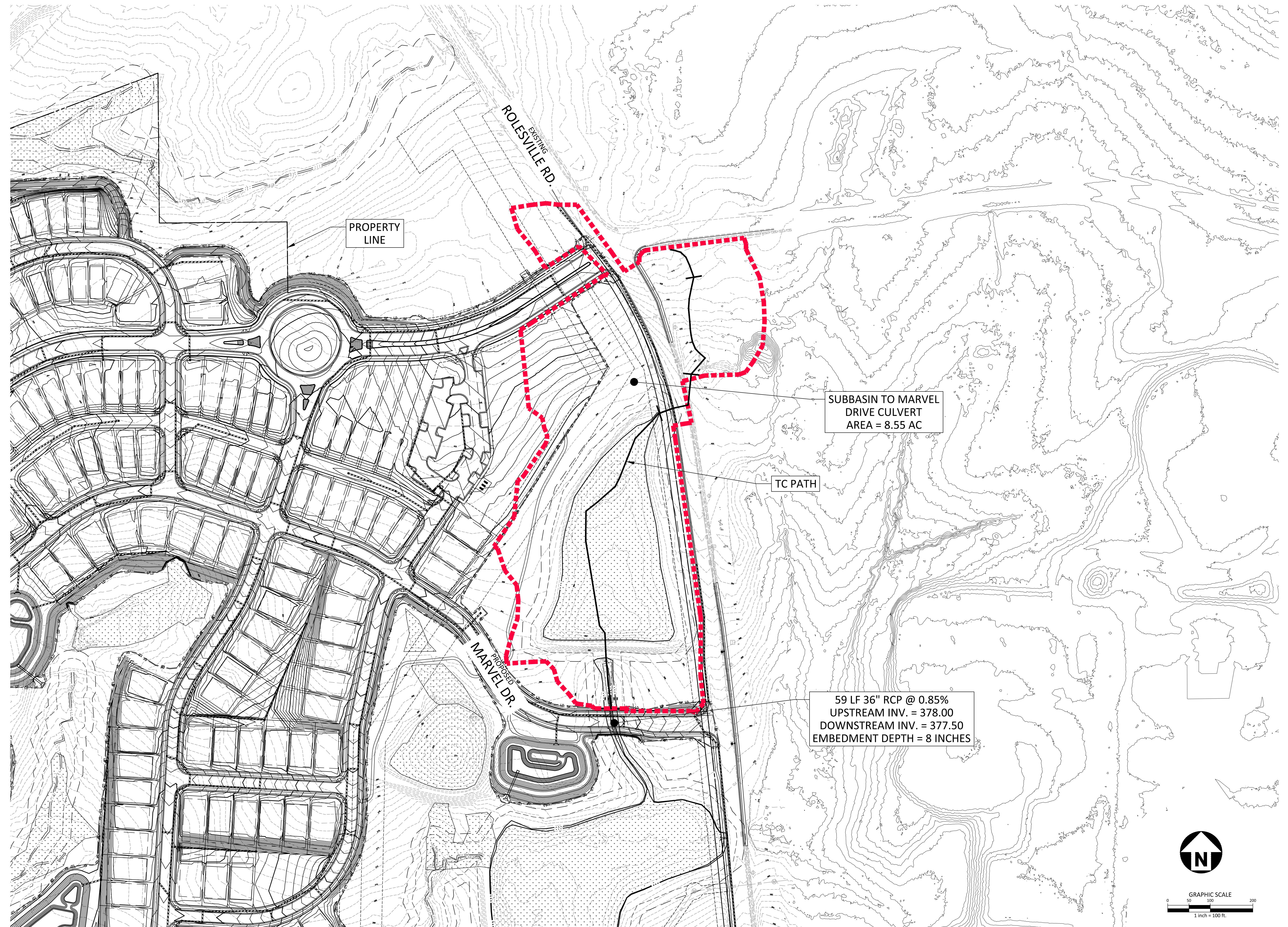
CLIENT

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5711 SIX FORKS ROAD, SUITE 300
RALEIGH, NORTH CAROLINA 27609
PHONE: 919.232.3695
CONTACT: BOB MISHLER



ASHTON WOODS™

**THE POINT
PHASES 1-10 AND 14
PRELIMINARY PLAT PLANS
EAST YOUNG STREET
TOWN OF ROLESVILLE, WAKE FOREST TOWNSHIP,
WAKE COUNTY, NORTH CAROLINA**



REVISIONS

NO.	DATE	COMMENTS
1	04.09.2020	REV PER TOWN COMMENTS
2	06.19.2020	REV PER MUNICIPAL COMMENTS
3	08.21.2020	REV PER MUNICIPAL COMMENTS

PLAN INFORMATION

PROJECT NO. AWH-20000
FILENAME AWH20000-CULVERT
CHECKED BY DCW
DRAWN BY CJ
SCALE 1" = 100'
DATE 11.25.2020

SHEET

CULVERT DRAINAGE AREA MAP

CULVERT